DEPARTMENT OF DEFENSE

UNITED STATES OF AMERICA

CAIS STANDARD MANUAL

SYSTEM NO. 10
BUILDING ELECTRICAL

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CAS PROJECT
CAIS MANUAL

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MEMORANDUM FOR DTIC-OCP
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SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
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2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

Larry L. Testerman
LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

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ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed, including infrastructure, will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a related list of components. Detailed observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys
This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys
This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Building Electrical System.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

Level I Inspection Method for building electrical assets consist of a thorough inspection of electrical equipment and raceway systems located within the building and as described in the works breakdown structure. Building electrical standard inspection is essentially a walk-by inspection with observations and measurements. This standard inspection is essentially designed to be performed by one person and is to be made without changing the operational status of the electrical equipment. The inspector is not to operate the electrical equipment while performing a Level I Inspection Method, except in a case of an emergency.

B. Level II Inspection Method

Level II inspection is an extension of Level I inspection and performed concurrently with Level I inspection. The standard inspection is essentially designed to be performed by two persons due to the complexity of the survey and safety requirements. One will be a CAS certified electrical inspector and the other a local facility electrical maintenance man qualified for both low and medium voltage systems.

In some cases the electrical equipment may not be operating or is partially or entirely enclosed. To perform a meaningful survey the equipment is to be operated where possible and panels where enclosed and doors are to be opened. Where possible, the panels and doors will be opened without de-energizing the associated equipment. This standard inspection is essentially a walk-by inspection, with equipment operating and/or panels and doors opened, making meaningful observations and measurements possible.

The facility electrical maintenance man should coordinate with the facility manager as to what equipment can be operated during the time of the survey.

C. Level III Inspection Method

Defect/observation data from Level I and II Inspections, of a given item, may indicate the requirement for a more in-depth inspection to analyze its condition. This type of inspection is to be performed by individual experts knowing the operation and problem areas of the item being inspected. Level III inspection guide sheets should indicate the type of specialized equipment, methods, and inspector required and the procedure this inspection is to follow.

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II. GENERAL INSPECTION

A. Process

The inspection is normally conducted at the component level. Figure 10.00-A provides the work breakdown from system through component for the Building Electrical area.

The inspector will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the inspector will be provided a list of defects, each of which is described further as observations. These observations are described to various levels of severity as they relate to their effect on the life of the system. The quantification of each deficiency is identified by the inspector using the associated unit of measure. Once an observation is populated with a defect quantity, the inspector will be requested to provide information on component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information. This can be overridden by the inspector, Site CAIS personnel, or Facility Manager.

B. Location

Level I and II inspections will be located by the inspector through a discrete entry into the Data Collection Device. The "IU" or component location will be derived from Facility-supplied segment numbering lists, maps or other I.D. numbering systems. For building associated "IU's" and components the Facility shall furnish plans annotated with room number schedules. In the case of non-room associated components, plans will be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no maps, or plans are available the inspector shall enter a brief (65 character) description of location.

III. INSPECTION QUALIFICATIONS

Minimum inspector qualifications, for the Building Electrical System, require a five year journeyman. Experience or familiarity in the areas of building electrical power system construction is desirable but not required. All of the survey requirements for this system can be accomplished by a single CAS surveyor, however, safety and other considerations will require the inspector to work with local electrical maintenance personnel that are low and medium voltage system qualified. CAS surveyors will be trained in the CAS System and its usage, and will be CAIS Certified.

IV. INSPECTION UNIT (IU)

<u>Example:</u> The IU is normally defined at the subsystem level. If the unit of measure at the subsystem level is each, then the IU is each. If the unit of measure is square feet or linear feet, the IU is determined by the identification of location (i.e., a deck level or quadrant). Occasionally the IU will occur at the component level. Where this occurs it will be noted in the component description.

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IU's may include one occurrence of each component or multiple occurrence of a single component (e.g., multiple circuit breakers can occur in a motor control center, but only one enclosure). Deficiency quantities are captured by the inspector for each occurrence within the discrete component (deficiency quantities are tied to each circuit breaker as a unique component, but the component Enclosure may have only one discrete unit since it is a continuous enclosure housing many circuit breakers).

For Example: The inspector locates 2 EA of hot bus connections in vertical cubicle No 1 of the enclosure. A quantity of "2" is recorded in the Field CAIS for the component enclosure located by the IU defined at the subsystem level as Motor Control Center. As the inspection continues on the IU, the inspector finds another 1 EA hot bus connection in vertical cubicle No 2. This is recorded by editing the initial 2 EA to read 3 EA with a number of occurrence as two. The IU itself is the entire Enclosure, the discrete component is a single cubicle. As the inspector moves to a different component, such as motor starters, multiple discrete components may exist. Deficiency quantities will be tied to each discrete component enclosure, which is in turn a component of the Motor Control Center. So defects captured in the first cubicle will be linked together and distinguished from defects captured in the 2nd, 3rd, 4th ---cubicles.

For the above example, an occurrence is defined as a defect (or observation) which is detected within the inspector's line of vision. If the inspector has multiple defects (or observations) in an occurrence within the same discrete component, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component.

For Example: 10 EA bus connections are running hot but of those, 7 EA are running 25°C or more above ambient temperature. The inspector will quantify 7 EA under "Bus connections 25°C or more above ambient" and 3 EA under "Bus connection 5° to 24°C above ambient.

V. UNIT COSTS

The unit cost that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

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VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the inspection.

Inspector may utilize the following protective gear:

- Hard hat - to be worn in designated areas
- Safety glasses - to be worn in designated areas
- Safety shoes - to be worn during all inspections
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling
- Gloves, electrical insulated - to be worn when working around live electrical components

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all inspections
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 25'
Tool bag
Screwdrivers with insulated handle -
Phillips
Straight slot
Pliers with insulated handles

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular method. Inspectors should review these sections in order to determine any special tool requirements for subsystems they are to inspect.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II is flagged. The Level II Key at the observation level will refer to a specific Guide Sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

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X. LEVEL III INSPECTION METHOD KEYS

Certain observations will reference a Level III Inspection Method. The Facility Manager will be able to identify deficiencies where a Level III is flagged. The Level III Key at the observation Level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of abbreviations used in this system are contained in Appendix A which is located at the end of Building Electrical.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Building Electrical.

Appendix C - Life Cycles

A listing of the average life cycle durations for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspection for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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Figure 10-A. WORK BREAKDOWN STRUCTURE

SYSTEM / **SUB-SYSTEM** / **COMPONENT**

- 10 BUILDING ELECTRICAL
  - 10.01 Service Entrance 600v or Less
    - 10.01.01 Metering
    - 10.01.02 Circuit Breakers (Low Voltage)
    - 10.01.03 Disconnect Switches (Low Voltage)
  - 10.02 Low Voltage Distribution System 600v or Less
    - 10.02.01 Circuit Breakers (Low Voltage)
    - 10.02.02 Disconnect Switches (Low Voltage)
    - 10.02.03 Transfer Switches
    - 10.02.04 Motor Starters/Contactors
    - 10.02.05 Power Regulators
    - 10.02.06 Transformers
    - 10.02.07 Variable Frequency Drives
    - 10.02.08 End Use Device Connections
  - 10.03 Lighting
    - 10.03.01 Lighting Fixtures - Fluorescent
    - 10.03.02 Lighting Fixtures - incandescent
    - 10.03.03 Lighting Fixtures - High Intensity Discharge (HID)
    - 10.03.04 Luminous Ceilings
    - 10.03.05 Lighting Controllers
  - 10.04 Power Control
    - 10.04.01 Control Panels
    - 10.04.02 Control Stations
  - 10.05 Grounding System
    - 10.05.01 Instrumentation Grounding System
    - 10.05.02 Bonding
  - 10.06 Raceways
    - 10.06.01 Busways/Busducts
    - 10.06.02 Cable Trays
    - 10.06.03 Conduit Systems
    - 10.06.04 Wireways
    - 10.06.05 Underfloor/Infloor Duct System
  - 10.07 Power Sources
    - 10.07.01 Battery Racks
    - 10.07.02 Battery Chargers
    - 10.07.03 Battery Storage
    - 10.07.04 Motor-Generator Sets
    - 10.07.05 Solid State Frequency Converters
    - 10.07.06 Solid State Uninterruptible Power Supply (UPS)
    - 10.07.07 Solid State Power Conditioners
    - 10.07.08 Engine-Generators

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Figure 10-A. WORK BREAKDOWN STRUCTURE (Continued)

SYSTEM	SUB-SYSTEM	COMPONENT
10 BUILDING ELECTRICAL (Continued)	10.08 Motor Control Centers (MCC)	10.08.01 Enclosures With Bus Bars
		10.08.02 Circuit Breakers (Low Voltage)
		10.08.03 Disconnect Switches (Low Voltage)
		10.08.04 Motor Starters/Contactors
		10.08.05 Transformers
		10.08.06 Transfer Switches
	10.09 Switchboards	10.09.01 Enclosures With Bus Bars
		10.09.02 Metering
		10.09.03 Transfer Switches
		10.09.04 Circuit Breakers (Low Voltage)
		10.09.05 Disconnect Switches (Low Voltage)
	10.10 Panelboards	10.10.01 Enclosures With Bus Bars
		10.10.02 Circuit Breakers (Low Voltage)
		10.10.03 Disconnect Switches (Low Voltage)
		10.10.04 Motor Starters/Contactors
	10.11 Substations	10.11.01 Enclosures With Bus Bars
		10.11.02 Metering
		10.11.03 Surge (Lightning) Arresters
		10.11.04 Circuit Breakers (Medium Voltage)
		10.11.05 Circuit Breakers (Low Voltage)
		10.11.06 Disconnect Switches (Medium Voltage)
		10.11.07 Disconnect Switches (Low Voltage)
		10.11.08 Transformers

10.01 SERVICE ENTRANCE, 600V OR LESS

DESCRIPTION

Service Entrance is a subsystem of the Building Electrical system. Service Entrance consist of electrical devices and interconnecting conductors required to bring the electrical service from the site wide electrical utility service drop to the building distribution center.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tool, beyond the requirements listed in the Standard Tool Section shall be provided to perform the inspection of the Service Entrance Subsystem:

1. Infrared scanner, Raytek Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Service Entrance subsystem beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.01.01 METERING
- ◆ 10.01.02 CIRCUIT BREAKERS (LOW VOLTAGE)
- ◆ 10.01.03 DISCONNECT SWITCHES (LOW VOLTAGE)

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.01 SERVICE ENTRANCE, 600V OR LESS

COMPONENTS

◆ 10.01.01 METERING

Metering consists of devices used to measure voltage, current and Kilowatt Hour (KWH) usage at given locations. KWH metering may include measuring peak demand loads over a billing period on a continuous basis or a 24 hour on-peak / off-peak load basis. The KWH and peak demand loads are usually measured by a single meter unit.

Depending on voltage levels, voltage signal for metering purposes can be taken directly across lines or from potential transformers connected across lines being monitored.

Depending on voltage levels and maximum current flow, ampere signals for metering purposes can be taken from current flow through the meters or signals from either shunts or current transformers connected to the lines being metered.

Current and voltage readings at metering points can be taken with individual meters or selector switches can be used in conjunction with meters such that a single ampere or volt meter along with its individual selector switch can read the current or voltage at multi metering points.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

* **Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Glass broken or missing. ***{Severity M}	EA		
e. Selector switch broken or missing. ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Meter broken. ***{Severity H}	EA		1

10.01 SERVICE ENTRANCE, 600V OR LESS

COMPONENTS (Continued)

◆ 10.01.01 METERING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	1	2
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	1	2

10.01 SERVICE ENTRANCE, 600V OR LESS

COMPONENTS (Continued)

◆ 10.01.02 CIRCUIT BREAKERS (LOW VOLTAGE)

Circuit breakers (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. They contain built-in over current and under voltage devices to protect down stream conductors and equipment from overcurrent loads. These breakers can be operated automatically by built-in devices or by manually built-in toggle switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Circuit breaker broken or damaged. ***{Severity H}	EA	2	
g. Security device missing or inoperative. ***{Severity H}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	3	3
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	3	3

10.01 SERVICE ENTRANCE, 600V OR LESS

COMPONENTS (Continued)

◆ 10.01.03 DISCONNECT SWITCHES (LOW VOLTAGE)

Disconnect switches (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. Two types of disconnect switches are fused or non-fused. Disconnect switches are normally manually operated but could be electrically operated.

Disconnect switch with a fuse unit provides both overload and short circuit protection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Door handle bent or inoperative. ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Security device missing or inoperative. ***{Severity H}	EA		
g. Carbon tracking due to flashovers. ***{Severity H}	EA	4	
h. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	4	

10.01 SERVICE ENTRANCE, 600V OR LESS

COMPONENTS (Continued)

◆ 10.01.03 DISCONNECT SWITCHES (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal, blade end or fuse clip 5° to 24°C above ambient. ***{Severity M}	EA	5	4
b. Terminal, blade end or fuse clip 25°C or more above ambient. ***{Severity H}	EA	5	4

10.01 SERVICE ENTRANCE, 600V OR LESS

REFERENCES

1. DOE CAS Manual, Volume 9:0.09 Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.01 SERVICE ENTRANCE, 600V OR LESS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.01.01-1
2	GS-II 10.01.02-2
3	GS-II 10.01.02-3
4	GS-II 10.01.03-4
5	GS-II 10.01.03-5

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.01.01-1
2	GS-III 10.01.01-2
3	GS-III 10.01.02-3
4	GS-III 10.01.03-4

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: METERING
CONTROL NUMBER: GS-II 10.01.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-II 10.01.01-1

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.01.02-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.01.02-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.01.02-3

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.01.03-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.01.03-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.01.03-5

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.01.01-1

Application

This guide applies to the investigation of a broken meter that has received physical damage or is not operating.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. For physically damaged units, inspect to verify if the unit is damaged to the point where it is no longer sealed from dust, water or insects entering the housing. If the seal is broken the housing should be replaced and the existing meter should be repaired or discarded.

2. If the meter is not operating, follow the following procedure:

   a. Check all fuses and replace those fuses that are blown.
   b. Check current transformers (CT) for output when power is being used. CT may be burnt out or overloaded. CT secondary circuit must not be opened or overloaded when current flows through the primary. Under the above operating conditions the CT could be destroyed.
   c. Check potential transformers (PT) for output when power is on. PT may not provide the proper voltage output.
   d. Check selector switches for proper operation and low contact resistance. If switch is malfunctioning it should be replaced.
   e. Check circuitry for proper connections. Any improper connection could cause damage to the meter, CT or PT. Damaged devices need to be repaired or replaced.
   f. Check all electrical terminals for loose connections and tighten those required.
   g. Check for broken and insulation-damaged conductors. Replace conductors as required.
   h. After the above items have been checked out, the necessary repairs and replacements have been made and the meter is still malfunctioning, the meter should be replaced and the original meter sent to the shop for repair or scrapping.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.01.01-1

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.01.01-2

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.01.01-2

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.01.02-3

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.01.02-3

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.01.03-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.01.03-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

DESCRIPTION

Low Voltage Distribution System is a subsystem of Building Electrical system. Low Voltage Distribution System consist of electrical devices and interconnecting conductors required to distribute the electrical power from where it enters the building to the end use devices located throughout the building. The Low Voltage Distribution System will condition the power and change the voltage level as required by the individual end use devices.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tool, beyond the requirements listed in the Standard Tool Section shall be provided to perform the inspection of the Low Voltage Subsystem:

1. Infrared scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Low Voltage Distribution Subsystem beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.02.01 CIRCUIT BREAKERS (LOW VOLTAGE)
- ◆ 10.02.02 DISCONNECT SWITCHES (LOW VOLTAGE)
- ◆ 10.02.03 TRANSFER SWITCHES
- ◆ 10.02.04 MOTOR STARTERS/CONTACTORS
- ◆ 10.02.05 POWER REGULATORS
- ◆ 10.02.06 TRANSFORMERS
- ◆ 10.02.07 VARIABLE FREQUENCY DRIVES
- ◆ 10.02.08 END USE DEVICE CONNECTIONS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.04 POWER CONTROL
10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

COMPONENTS

◆ 10.02.01 CIRCUIT BREAKERS (LOW VOLTAGE)

Circuit breakers (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. They contain built-in overcurrent and under voltage devices to protect down stream conductors and equipment from overcurrent loads. These breakers can be operated automatically by built-in devices or by manually built-in toggle switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Circuit breaker broken or damaged. ***{Severity H}	EA	1	
g. Security device missing or inoperative. ***{Severity H}	EA		

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.01 CIRCUIT BREAKERS (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	2	1
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	2	1

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.02 DISCONNECT SWITCHES (LOW VOLTAGE)

Disconnect switches (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. Two types of disconnect switches are fused or non-fused. Disconnect switches are normally manually operated but could be electrically operated.

Disconnect switch with a fuse unit provides both overload and short circuit protection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Door handle bent or inoperative. ***{Severity M}	EA		
e. Unused openings not covered. ***{Severity M}	EA		
f. Security device missing or inoperative. ***{Severity H}	EA		
g. Carbon tracking due to flashovers. ***{Severity H}	EA	3	
h. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	3	

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.02 DISCONNECT SWITCHES (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal, blade end or fuse clip 5° to 24°C above ambient. ***{Severity M}	EA	4	2
b. Terminal, blade end or fuse clip 25°C or more above ambient. ***{Severity H}	EA	4	2

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.03 TRANSFER SWITCHES

Transfer switch has two power inputs, each from a separate power source and a single output to feed a given load. The purpose of the switch is to provide a means of transferring the load from one power source to another without remaking manual connections.

Transfer switches can be manually operated or both manually and automatically operated.

Transfer switches may be mounted independently or in substations, switchboards or motor control centers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Pilot light damaged or inoperative. ***{Severity L}	EA		
d. Interior not clean or moisture free. ***{Severity L}	EA	5	
e. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Handle bent or inoperative. ***{Severity H}	EA		

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.03 TRANSFER SWITCHES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (continued):**			
Observation:			
h. Security device missing or inoperative.	EA		
***{Severity H}			
i. Carbon tracking due to flashovers.	EA	5	
***{Severity H}			
j. Discoloration of blades and contacts due to overheating.	EA	5	
***{Severity H}			
k. Unit not grounded.	EA	5	
***{Severity H}			

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient.	EA	6	3
***{Severity M}			
b. Terminal 25°C or more above ambient.	EA	6	3
***{Severity H}			

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.04 MOTOR STARTERS/ CONTACTORS

Motor starters are devices housed in an enclosure and used for controlling electrical motors. These devices consist of the following: disconnect switches, circuit breakers, contactors, control transformers, fuses, various types of relays, pushbuttons, selector switches, pilot lights, metering devices, etc. Required components depend on the complexity of the motor control function. Control functions provided by motor starters are; starting, accelerating, reversing rotation, cycling, jogging and stopping electrical motors. The complexity of control functions depends on the operational requirements the motors are to fulfill.

Magnetic and auxiliary contactors are used to switch lighting and heating loads, capacitors, transformers and electric motors where overload protection is separately provided. Contactors can be used as accessories to various pieces of equipment such as disconnect switches, circuit breakers, light controls or operate alone with its own accessories.

Circuit breakers and disconnect switches located in motor starters will be inspected under a separate component. The motor starter housing and devices therein will be inspected by this standard.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Pilot light damaged or inoperative. ***{Severity L}	EA		
c. Metering device loose or damaged. ***{Severity L}	EA		
d. Panel fastener loose, broken or missing. ***{Severity L}	EA		

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.04 MOTOR STARTERS/ CONTACTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage: (Continued)**			
e. Interior not clean or moisture-free. ***{Severity L}	EA	7	
f. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
g. Control device loose or damaged. ***{Severity M}	EA		
h. Unused opening not covered. ***{Severity M}	EA		
i. Door handle bent or inoperative. ***{Severity H}	EA		
j. Security devices missing or inoperative. ***{Severity H}	EA		
k. Unit not grounded. ***{Severity H}	EA	7	

Defect:

*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	8	4
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	8	4

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.05 POWER REGULATORS

Power regulators provide current, voltage, and power factor regulation to various types of equipment through the use of transformers, relays, filters, inverters, capacitors and various components that make up regulators.

Current regulators (dry or liquid) provide constant current output for fluctuating loads. Constant voltage regulators provide constant voltage output with fluctuating voltage inputs. Power factor regulators correct the power factors of loads to within a given range.

Pole mounted power regulators will not be inspected.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Switch or pushbutton damaged or inoperative. ***{Severity M}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Ventilation obstructed. ***{Severity L}	EA		
d. Unit mounting loose, broken or missing. ***{Severity L}	EA		
e. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Cover missing. ***{Severity M}	EA		
h. Unit not grounded. ***{Severity H}	EA	9	
i. Gauge or meter broken or missing. ***{Severity M}	EA		
j. Security lock missing or inoperable. ***{Severity H}	EA		

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.05 POWER REGULATORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal connection 5° to 24°C above ambient. ***{Severity M}	EA	10	6
b. Terminal connection 25°C or more above ambient. ***{Severity H}	EA	10	6

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Oil Leak:**			
Observation:			
a. Oil on surface of tank (signs of oil leak). ***{Severity L}	EA		11
b. Oil puddle under or around base of tank. ***{Severity H}	EA		11

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Overload:**			
Observation:			
a. Constant current regulator KVA rating exceeded. ***{Severity H}	EA	17	12
b. Voltage regulator on maximum tap setting. ***{Severity H}	EA	17	12
c. Pur. fact. regulator correction below 0.9 PF. ***{Severity H}	EA	17	12

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.06 TRANSFORMERS

Transformers are static electric devices consisting of a single winding or multiple coupled windings with or without a magnetic core. Power is transferred by electromagnetic induction from the input to the output circuit usually with changed values of voltages and currents.

Transformers have six types of functions: power transformers converts one voltage source to another voltage power source, isolation transformers shields the load side winding from the line side winding, reduced voltage starting transformers reduces the motor terminal voltage during the starting cycle, buck/boost transformers either raise or lower output voltage to accommodate the load, current transformers proportions a high current flow to a low current flow for instrumentation and control purpose and potential transformers proportions a high voltage potential to a low voltage potential for instrumentation and control purposes.

Transformers, other than current and potential transformers, smaller than 5 kVA single phase or 15 kVA multi phase, will not be inspected. All current and potential transformers will be inspected.

Surge (lightning) arresters, insulators, foundations, poles and conductors bare will be inspected under separate components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		14
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		14

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Air intake/exhaust ducts blocked. ***{Severity M}	EA		

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.06 TRANSFORMERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (Continued):**			
e. Air filters dirty or missing. ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Cooling fan guard/blade broken or missing. ***{Severity H}	EA		
h. Unit not grounded. ***{Severity H}	EA		
i. Gauge or meter broken or missing. ***{Severity M}	EA		
j. Security lock missing or inoperable. ***{Severity H}	EA		
Defect:			
*** Oil Leak:**			
Observation:			
a. Oil on surface of tank (possible oil leak). ***{Severity L}	EA		13
b. Oil puddle under or around base of tank. ***{Severity H}	EA		13
Defect:			
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	11	7
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	11	7
c. Oil cooling fin blocked. ***{Severity H}	EA		14
d. Low oil level (less than 2" above fin). ***{Severity H}	EA		14

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.07 VARIABLE FREQUENCY DRIVES

Variable frequency drives convert the incoming AC power to DC power, then back to AC power at a frequency and voltage related to the desired motor speed. While the input frequency is the normal line frequency, the usable output frequency varies from less than 25 Hz to as much as 80 Hz.

The majority of the variable frequency drives are rated 600 volts or less but there are units available in the medium voltage range.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident).	SF		
***{Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
***{Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
***{Severity H}			

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing.	EA		
***{Severity L}			
b. Pilot light damaged or inoperative.	EA		
***{Severity M}			
c. Read out device or meter loose or damaged.	EA		
***{Severity M}			
d. Panel fastener loose, broken or missing.	EA		
***{Severity L}			
e. Enclosure damaged (cannot be sealed).	EA		
***{Severity M}			
f. Control device loose or damaged.	EA		
***{Severity M}			
g. Unused opening not covered.	EA		
***{Severity M}			
h. Door handle bent or inoperative.	EA		
***{Severity H}			

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.07 VARIABLE FREQUENCY DRIVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage: (Continued)**			
i. Security devices missing or inoperative. ***{Severity H}	EA		
j. Noisy operation. ***{Severity H}	EA		
k. Unit not grounded. ***{Severity H}	EA	12	
l. Switch or pushbutton damaged or broken. ***{Severity M}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	13	8
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	13	8

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	16	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	16	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	16	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	16	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	16	15
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	16	15
g. Load current more than 2% above FLC. ***{Severity H}	EA	16	15

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

COMPONENTS (Continued)

◆ 10.02.08 END USE DEVICE CONNECTIONS

End use devices use electrical power. These end use devices are electric unit heaters, welding receptacles, electric water heaters, electric kitchen appliances, etc.

Inspection of the end use devices will cover the termination of the incoming conductors. The remainder of the inspection of the end use devices are covered in other sections.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Excessive dust, dirt or moisture accumulation. ***{Severity L}	EA	14	
b. Conductor insulation damaged or carbon tracked. ***{Severity M}	EA	14	
c. Two or more conductor strands broken. ***{Severity H}	EA	14	
d. Unit not grounded. ***{Severity H}	EA	14	

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	15	9
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	15	9

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

REFERENCES

1. DOE CAS Manual, Volume 9:0.09 Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600V OR LESS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.02.01-1
2	GS-II 10.02.01-2
3	GS-II 10.02.02-3
4	GS-II 10.02.02-4
5	GS-II 10.02.03-5
6	GS-II 10.02.03-6
7	GS-II 10.02.04-7
8	GS-II 10.02.04-8
9	GS-II 10.02.05-9
10	GS-II 10.02.05-10
11	GS-II 10.02.06-11
12	GS-II 10.02.07-12
13	GS-II 10.02.07-13
14	GS-II 10.02.08-14
15	GS-II 10.02.08-15
16	GS-II 10.02.07-16
17	GS-II 10.02.05-17

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.02.01-1
2	GS-III 10.02.02-2
3	GS-III 10.02.03-3
4	GS-III 10.02.04-4
5	GS-III 10.02.05-5
6	GS-III 10.02.05-6
7	GS-III 10.02.06-7
8	GS-III 10.02.07-8
9	GS-III 10.02.08-9
10*	GS-III 10.02.06-10
11	GS-III 10.02.05-11
12	GS-III 10.02.05-12
13	GS-III 10.02.06-13
14	GS-III 10.02.06-14
15	GS-III 10.02.07-15

* Indicates guide sheets which are not directly referenced by a Key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.02.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.02.01-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.
2. Make temperature measurements with an infrared scanner.
3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.
4. Measure the temperature of the device specified.
5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.
6. Record the results.
7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.02.01-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.02.02-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.02.02-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.02.02-4

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.02.03-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.02.03-6

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.02.03-6

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.02.04-7

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.02.04-8

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.02.04-8

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9

COMPONENT: POWER REGULATORS
CONTROL NUMBER: GS-II 10.02.05-9

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 10

COMPONENT: POWER REGULATORS
CONTROL NUMBER: GS-II 10.02.05-10

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 10 (Continued)

COMPONENT: POWER REGULATORS
CONTROL NUMBER: GS-II 10.02.05-10

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-II 10.02.06-11

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.
2. Make temperature measurements with an infrared scanner.
3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.
4. Measure the temperature of the device specified.
5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.
6. Record the results.
7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11 (Continued)

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-II 10.02.06-11

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 12

COMPONENT: VARIABLE FREQUENCY DRIVES
CONTROL NUMBER: GS-II 10.02.07-12

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 13

COMPONENT: VARIABLE FREQUENCY DRIVES
CONTROL NUMBER: GS-II 10.02.07-13

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.
2. Make temperature measurements with an infrared scanner.
3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.
4. Measure the temperature of the device specified.
5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.
6. Record the results.
7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 13 (Continued)

COMPONENT: VARIABLE FREQUENCY DRIVES
CONTROL NUMBER: GS-II 10.02.07-13

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 14

COMPONENT: END USE DEVICE CONNECTIONS
CONTROL NUMBER: GS-II 10.02.08-14

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 15

COMPONENT: END USE DEVICE CONNECTIONS
CONTROL NUMBER: GS-II 10.02.08-15

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 15 (Continued)

COMPONENT: END USE DEVICE CONNECTIONS
CONTROL NUMBER: GS-II 10.02.08-15

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 16

COMPONENT: VARIABLE FREQUENCY DRIVE
CONTROL NUMBER: GS-II 10.02.07-16

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.
2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.
3. A Level II Help Screen Chart will convert readings to percentages by observation.
4. Close panels or doors carefully after the inspection is completed.
5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 16

COMPONENT: VARIABLE FREQUENCY DRIVE
CONTROL NUMBER: GS-II 10.02.07-16

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\%\text{ Overload} = \frac{(\text{Measured Current - Full Load Current})\text{ Times }100}{\text{Full Load Current}}$$

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 17

COMPONENT: POWER REGULATOR
CONTROL NUMBER: 10.02.05-17

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of up to 35 kV above ground.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Take power readings and inspect tap settings that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this piece of equipment.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.02.01-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.02.01-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.02.02-2

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.02.02-2

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-III 10.02.03-3

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-III 10.02.03-3

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-III 10.02.04-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-III 10.02.04-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: POWER REGULATOR
CONTROL NUMBER: GS-III 10.02.05-5

Application

This guide applies to the investigation of oil leaks in the power regulator tank that has signs of oil on surface of the tank or an oil puddle under or around base of tank.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by finding the source of the oil. If the oil is coming from an external source no further inspection of the power regulator is required. The external source should be identified and recommendations made to eliminate the contamination of the breaker.

2. If the oil source is coming from within the power regulator a determination should be made as how the oil is escaping.

3. If power regulator repairs are made, oil analysis should be made after the repairs to determine if the oil is contaminated.

4. All contaminated oil should be removed and replaced with new oil.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Brush

2. Non-flammable cleaning fluid

3. Wiping material

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: POWER REGULATORS
CONTROL NUMBER: GS-III 10.02.05-6

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: POWER REGULATORS
CONTROL NUMBER: GS-III 10.02.05-6

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-III 10.02.06-7

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-III 10.02.06-7

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: VARIABLE FREQUENCY DRIVES
CONTROL NUMBER: GS-III 10.02.07-8

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: VARIABLE FREQUENCY DRIVES
CONTROL NUMBER: GS-III 10.02.07-8

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: END USE DEVICE CONNECTIONS
CONTROL NUMBER: GS-III 10.02.08-9

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: END USE DEVICE CONNECTIONS
CONTROL NUMBER: GS-III 10.02.08-9

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10*

COMPONENT: TRANSFORMER-112½ kVA or larger, dry or liquid
CONTROL NUMBER: GS-III 10.02.06-10

Application

This guide applies to the inspection of a transformer as a component. This inspection, while it is part of the Condition Assessment Survey, it is triggered by information beyond the inspection process such as time, age, or repeated service calls.

Special Safety Requirements

Inspectors need to have complete control of the transformer while performing the inspection. During a portion of the inspection the transformer will be taken out of service. Therefore the inspection of the transformer will be scheduled accordingly to accommodate the inspection requirements. No other safety requirements are required for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate the transformer's maintenance log or records and review this material concerning the following:
   a. Recorded readings of current, voltage, temperature, liquid level and gas pressure. Current, voltage and temperature level readings, should be taken at time of peak loads. Liquid level readings should be taken at time of low loads. Vacuum/pressure readings are to be taken at times of peak and low loads.
   b. Recorded data of when liquid sample were taken and copies of the sample test results.
   c. Recorded dates of previous inspections and maintenance pulled.

2. Specify corrective action for problem areas:
   a. If there is no maintenance log recording either any one or all of the following: current, voltage, temperature, liquid level and gas pressure, the maintenance procedure should be revised to include the collection of this data. These readings should be taken on a weekly basis.
   b. If the current readings indicate the transformer is consistently being overloaded, either some of the load should be transferred to another transformer if possible or the transformer should be upgraded to take the full load without overloading.
   c. If the voltage readings indicate the transformer output voltage is more than $\pm 3\%$ of the rated output voltage, the load tops should be adjusted accordingly and if this doesn't solve the problem then studies should be made to determine the cause and what corrective action should be taken.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10* (Continued)

COMPONENT: TRANSFORMER-112½ kVA or larger, dry or liquid
CONTROL NUMBER: GS-III 10.02.06-10

d. If the temperature reading indicates the transformer temperature is above normal and the unit isn't overloaded, then either the cooling system isn't operating properly or the unit has an internal short. The first step is to clean all circulating air plates and exposed parts for good heat transfer. If this doesn't help, then do a complete testing on the winding, including resistance and tune ratio.
e. If the liquid level is low at no load, there may be a need to add liquid. The procedure to add liquid should be as specified by the manufacturer. Also if the liquid is low, a check should be made for leaks.
f. If the pressure gage readings are fairly constant or reads zero, the pressure gage is either broken or the tank has a leak. In either case tests should be performed to isolate the cause and correct the problem. A leaky tank may cause the liquid to become contaminated.

3. Provide additional inspection of the transformer as specified by the equipment manufacturer. If there is no such recommendation, then provide an inspection as outlined in NFPA 70B *"Recommended Practices for Electrical Equipment Maintenance"*, latest edition.

Special Tools and Equipment

The following is a list of special tools and equipment required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required
2. Infrared Scanner, Raytek Inc., CAT #PM2EM-L2
3. Torque wrench
4. Digital multimeter, Fluke #1TC67

Recommended Inspection Frequency

Follow manufacturers recommendations for frequency of inspection of the transformer for the first 3 years. If there is no manufacturer's recommendation than an annual inspection should be performed during this 3 year period. After the first 3 years of service, inspection frequency can be increased or decreased dictated by the past observations or experiences. When the number of service calls since the last inspection equals 2, the up-coming inspection should be performed immediately.

References

1. NFPA 70B, *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: POWER REGULATOR
CONTROL NUMBER: GS-III 10.02.05-11

Application

This guide applies to the investigation of oil leaks in the power regulator tank that has signs of oil on surface of the tank or an oil puddle under or around base of tank.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by finding the source of the oil. If the oil is coming from an external source no further inspection of the power regulator is required. The external source should be identified and recommendations made to eliminate the contamination of the breaker.

2. If the oil source is coming from within the power regulator, a determination should be made as how the oil is escaping.

3. If power regulator repairs are made, oil analysis should be made after the repairs to determine if the oil is contaminated.

4. All contaminated oil should be removed and replaced with new oil.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Brush

2. Non-flammable cleaning fluid

3. Wiping material

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12

COMPONENT: POWER REGULATOR
CONTROL NUMBER: GS-III 10.02.05-12

Application

This guide applies to the investigation of power regulators that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning overloading of the regulator.

2. For constant current regulator, determine if part of the load being supplied is no longer needed and should be shed, is it practical to transfer the load to another constant current regulator or if the constant current regulator needs to be replaced with a larger unit.

3. For voltage regulator, determine if the supply to the regulator can be upgraded by changing the taps on the upstream transformer, increase the size of any overloaded supply cable, part of the load no longer needs to be connected to the regulator and should be shed or if the voltage regulator needs to be replaced with a larger unit.

4. For power factor regulator, determine if the power factor of one or more of the larger loads could be corrected by adding individual capacitors that are switched with the load or if the power factor regulator needs to be replaced or modified.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter
2. Ampmeter
3. Power factor meter
4. Watthour meter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.02.06-13

Application

This guide applies to the investigation of oil leaks in the transformer tank that has signs of oil on surface of the tank or an oil puddle under or around base of tank.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by finding the source of the oil. If the oil is coming from an external source no further inspection of the transformer is required. The external source should be identified and recommendations made to eliminate the contamination of the breaker.

2. If the oil source is coming from within the transformer, a determination should be made as how the oil is escaping.

3. If transformer repairs are made, oil analysis should be made after the repairs to determine if the oil is contaminated.

4. All contaminated oil should be removed and replaced with new oil.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Brush

2. Non-flammable cleaning fluid

3. Wiping material

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.02.06-14

Application

This guide applies to the investigation of 112.5 kVA transformers or larger that contain liquids used as electrical insulation and coolant.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning cooling fin blockage or low liquid level.
2. Do a liquid analysis test.
3. If liquid analysis test results are okay, add liquid to proper level requirements.
4. If fin blockage remains, have liquid removed and clear the fin blockage.
5. If liquid analysis test results show contaminates, have the liquid removed, the contaminates flushed out and new liquid added.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared scanner
2. Tools and sampling containers for taking liquid samples and transferring these samples to the lab.
3. Tools and liquid supplies for adding the appropriate liquid to the transformer tank.

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15

COMPONENT: VARIABLE FREQUENCY DRIVE
CONTROL NUMBER: GS-III 10.02.07-15

Application

This guide applies to the investigation of variable frequency drives that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the variable frequency drive.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter

2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

10.03 LIGHTING

DESCRIPTION

Lighting is a subsystem of the Building Electrical system. Lighting consists of various types, sizes and shapes of lighting fixtures together with a wide range of lamp sources combined with a large variety of light controllers.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of lighting, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of lighting, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 10.03.01 LIGHTING FIXTURES - FLUORESCENT
- 10.03.02 LIGHTING FIXTURES - INCANDESCENT
- 10.03.03 LIGHTING FIXTURES - HIGH INTENSITY DISCHARGE (HID)
- 10.03.04 LUMINOUS CEILINGS
- 10.03.05 LIGHTING CONTROLLERS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.03 LIGHTING

COMPONENTS

◆ 10.03.01 LIGHTING FIXTURES - FLUORESCENT

Lighting fixtures, also known as luminaires, are devices that transform electrical energy to energy in the visible spectrum.

Fluorescent lighting fixture assemblies consist of housing, ballasts, lamps, lens, reflectors, sockets and emergency battery packs.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident).	SF		
***{Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
***{Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
***{Severity H}			

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Fixture lens door broken or missing.	EA		
***{Severity L}			
b. Dirty or discolored lens.	EA		
***{Severity L}			
c. Battery test switch broken or missing.	EA		
***{Severity L}			
d. Fixture not adequately secured.	EA		
***{Severity M}			
e. Lighting lens broken or missing.	EA		
***{Severity M}			
f. Socket broken or missing.	EA		
***{Severity M}			
g. Fixture inoperative.	EA	1	1
***{Severity M}			
h. Bad ballast (noisy).	EA		
***{Severity M}			
i. Lamp missing.	EA		
***{Severity M}			
j. Fixture housing damaged or missing.	EA		
***{Severity H}			
k. Interior not moisture-free.	EA		
***{Severity H}			

10.03 LIGHTING

COMPONENTS (Continued)

◆ 10.03.02 LIGHTING FIXTURES - INCANDESCENT

Lighting fixtures, also known as luminaires, are devices that transform electrical energy to energy in the visible spectrum.

Incandescent lighting fixture assemblies consist of housing, lamps, lens, reflectors, sockets and baffles. Exit and emergency battery units will be inspected under this component.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Fixture lens door broken or missing. ***{Severity L}	EA		
b. Dirty or discolored lens. ***{Severity L}	EA		
c. Fixture not adequately secured. ***{Severity M}	EA		
d. Lighting lens broken or missing. ***{Severity M}	EA		
e. Safety guard/louver broken or missing. ***{Severity M}	EA		
f. Reflector broken or missing. ***{Severity M}	EA		
g. Socket broken or missing. ***{Severity M}	EA		
h. Fixture inoperative. ***{Severity M}	EA	2	2

10.03 LIGHTING

COMPONENTS (Continued)

◆ 10.03.02 LIGHTING FIXTURES - INCANDESCENT (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (Continued):**			
i. Lamp missing. ***{Severity M}	EA		
j. Lighting baffle burned, broken or missing. ***{Severity M}	EA		
k. Fixture housing damaged or missing. ***{Severity H}	EA		
l. Interior not moisture-free. ***{Severity H}	EA		

10.03 LIGHTING

COMPONENTS (Continued)

◆ 10.03.03 LIGHTING FIXTURES - HIGH INTENSITY DISCHARGE (HID)

Lighting fixtures, also known as luminaires, are devices that transform electrical energy to energy in the visible spectrum.

HID Lighting fixture assemblies consist of housing, ballasts, lamps, lens, reflectors and sockets.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Fixture lens door broken or missing. ***{Severity L}	EA		
b. Dirty or discolored lens. ***{Severity L}	EA		
c. Fixture not adequately secured. ***{Severity M}	EA		
d. Lighting lens broken or missing. ***{Severity M}	EA		
e. Reflector broken or missing. ***{Severity M}	EA		
f. Socket broken or missing. ***{Severity M}	EA		
g. Safety guard/louver broken or missing. ***{Severity M}	EA		
h. Fixture inoperative. ***{Severity M}	EA	3	3
i. Bad ballast (noisy). ***{Severity M}	EA		
j. Lamp missing. ***{Severity M}	EA		
k. Fixture housing damaged or missing. ***{Severity H}	EA		
l. Interior not moisture-free. ***{Severity H}	EA		

10.03 LIGHTING

COMPONENTS (Continued)

◆ 10.03.04 LUMINOUS CEILINGS

Luminous ceiling is a lighting system which consists of a continuous surface area of diffusing, light-controlling lens or louvers with lighting fixtures mounted above it.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Structural support/hanger rods loose or missing. ***{Severity M}	EA		
b. Structural support hanger brackets loose or missing. ***{Severity M}	EA		
c. Wall angle or ceiling tee support loose or bent. ***{Severity M}	LF		
d. Open suspended plastic lens broken or missing. ***{Severity H}	SF		
e. Closed suspended plastic lens broken or missing. ***{Severity H}	SF		
f. Open suspended metal louver lens broken, bent or missing. ***{Severity H}	SF		

10.03 LIGHTING

COMPONENTS (Continued)

◆ 10.03.05 LIGHTING CONTROLLERS

Lighting controllers turn the lighting fixtures on/off and in some instances control the brightness of the lights. Controllers consist of on/off switches, dimmers, contactors, motion/occupancy sensors, photocells and time clocks.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Discolored switch. ***{Severity L}	EA		
c. Noisy dimmer. ***{Severity L}	EA		
d. Motion/occupancy sensor inoperative. ***{Severity L}	EA	4	4
e. Motion/occupancy sensor housing broken. ***{Severity L}	EA		
f. Photocell housing broken. ***{Severity L}	EA		
g. Time clock mechanism broken. ***{Severity L}	EA		
h. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
i. Unused openings not covered. ***{Severity M}	EA		
j. Switch cover plate broken or missing. ***{Severity H}	EA		
k. On/off switch handle broken. ***{Severity H}	EA		
l. Dimmer switch broken. ***{Severity H}	EA		

10.03 LIGHTING

REFERENCES

1. DOE CAS Manual, Volume 9: 0.09 Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.03 LIGHTING

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.03.01-1
2	GS-II 10.03.02-2
3	GS-II 10.03.03-3
4	GS-II 10.03.05-4

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.03.01-1
2	GS-III 10.03.02-2
3	GS-III 10.03.03-3
4	GS-III 10.03.05-4

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: LIGHTING FIXTURES - FLUORESCENT
CONTROL NUMBER: GS-II 10.03.01-1

Application

This guide applies to lighting fixtures and motion/occupancy sensors that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify if the branch circuit disconnecting means is in the "on" operation.

2. Verify if the light controller is in the "on" mode.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: LIGHTING FIXTURES - INCANDESCENT
CONTROL NUMBER: GS-II 10.03.02-2

Application

This guide applies to lighting fixtures and motion/occupancy sensors that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify if the branch circuit disconnecting means is in the "on" operation.

2. Verify if the light controller is in the "on" mode.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: LIGHTING FIXTURES - HIGH INTENSITY DISCHARGE (HID)
CONTROL NUMBER: GS-II 10.03.3-3

Application

This guide applies to lighting fixtures and motion/occupancy sensors that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify if the branch circuit disconnecting means is in the "on" operation.

2. Verify if the light controller is in the "on" mode.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: LIGHT CONTROLLERS
CONTROL NUMBER: GS-II 10.03.05-4

Application

This guide applies to lighting fixtures and motion/occupancy sensors that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify if the branch circuit disconnecting means is in the "on" operation.

2. Verify if the light controller is in the "on" mode.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: LIGHTING FIXTURES - FLUORESCENT
CONTROL NUMBER: GS-III 10.03.01-1

Application

This guide applies to lighting fixtures that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Determine if there is voltage at the fixture and at the lamp(s).
2. Replace the lamp(s) in the lighting fixture.
3. Replace the ballast in the lighting fixture.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67
2. 6' Fiberglass Step Ladder

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level I inspection.

References

1. *"Handbook of Building and Plant Maintenance, Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: LIGHTING FIXTURES - INCANDESCENT
CONTROL NUMBER: GS-III 10.03.02-2

Application

This guide applies to lighting fixtures that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Determine if there is voltage at the fixture and at the lamp(s).
2. Replace the lamp(s) in the lighting fixture.
3. Replace the ballast in the lighting fixture.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67
2. 6' Fiberglass Step Ladder

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level I inspection.

References

1. *"Handbook of Building and Plant Maintenance, Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: LIGHTING FIXTURES - HIGH INTENSITY DISCHARGE (HID)
CONTROL NUMBER: GS-III 10.03.03-3

Application

This guide applies to lighting fixtures that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Determine if there is voltage at the fixture and at the lamp(s).
2. Replace the lamp(s) in the lighting fixture.
3. Replace the ballast in the lighting fixture.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67
2. 6' Fiberglass Step Ladder

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level I inspection.

References

1. *"Handbook of Building and Plant Maintenance, Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: LIGHT CONTROLLERS
CONTROL NUMBER: GS-III 10.03.05-4

Application

This guide applies to motion/occupancy sensors that are inoperative.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify that the manual switch is in the "on" position.
2. Activate the manual by-pass switch.
3. Determine if there is voltage at the motion/occupancy sensor.
4. Replace the motion/occupancy sensor.

Special Tools and Equipment

1. Digital multimeter, Fluke #1TC67
2. 6′ fiberglass step ladder

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level II inspection.

References

1. *"Handbook of Building and Plant Maintenance, Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.04 POWER CONTROL

DESCRIPTION

Power Control is a subsystem of the Building Electrical System. Power control consists of control panels and control stations which includes pilot lights, switches, pushbuttons, alarms and meters. These units are used to control and monitor electrical components.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of power control, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of power control, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.04.01 CONTROL PANELS
- ◆ 10.04.02 CONTROL STATIONS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM < 600V

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

COMPONENTS

◆ 10.04.01 CONTROL PANELS

Control panels may be mounted in motor control centers, substations, on equipment housings or on its own individual mounting frame. Enclosure of the control panel shall be suitable for the environment where it is located.

10.04 POWER CONTROL

COMPONENTS (Continued)

◆ 10.04.01 CONTROL PANELS (Continued)

The control panel consists of pilot lights, meters, audible and visual alarms to monitor the equipment and pushbuttons, switches, and relays to control the equipment. A control panel consists of numerous combinations of control and monitoring devices for controlling a single piece of equipment or a complex system including many pieces of equipment.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Pilot light damaged or inoperative. ***{Severity L}	EA		
d. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Pushbutton broken or missing. ***{Severity M}	EA		
g. Selector switch broken or missing. ***{Severity M}	EA		
h. Transformer discolored or blistered due to overheating. ***{Severity M}	EA	1	
i. Door handle bent or inoperative. ***{Severity H}	EA		
j. Security devices missing or inoperative. ***{Severity H}	EA		

10.04 POWER CONTROL

COMPONENTS (Continued)

◆ 10.04.01 CONTROL PANELS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Control transformer 5° to 24°C above ambient. ***{Severity M}	EA	2	1
b. Control transformer 25°C or more above ambient. ***{Severity H}	EA	2	1

10.04 POWER CONTROL

COMPONENTS (Continued)

◆ 10.04.02 CONTROL STATIONS

Control stations are mounted on equipment housings or on its own individual mounting frame. Enclosure of the control station shall be suitable for the environment where it is located.

The control station consists of pilot lights, pushbuttons, and switches, to control and monitor a single piece of equipment.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Pilot light damaged or inoperative. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Pushbutton broken or missing. ***{Severity M}	EA		
f. Selector switch broken or missing. ***{Severity M}	EA		
g. Security devices missing or inoperative. ***{Severity H}	EA		

10.04 POWER CONTROL

REFERENCES

1. Allen Bradley Company

10.04 POWER CONTROL

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.04.01-1
2	GS-II 10.04.01-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.04.01-1

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: CONTROL PANELS
CONTROL NUMBER: GS-II 10.04.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: CONTROL PANELS
CONTROL NUMBER: GS-II 10.04.01-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: CONTROL PANELS
CONTROL NUMBER: GS-II 10.04.01-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CONTROL PANELS
CONTROL NUMBER: GS-III 10.04.01-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: CONTROL PANELS
CONTROL NUMBER: GS-III 10.04.01-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

10.05 GROUNDING SYSTEM

DESCRIPTION

Grounding is a subsystem of the Building Electrical System. The grounding system consists of ground electrodes, grounding conductors, connections and other fittings required to complete the system.

A grounding system provides a path to ground by which the electrical current is dissipated without causing physical damage or loss of life and property.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of lighting, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Grounding System, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 10.05.01 INSTRUMENTATION GROUNDING SYSTEM
- 10.05.02 BONDING

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.05 GROUNDING SYSTEM

COMPONENTS

◆ 10.05.01 INSTRUMENTATION GROUNDING SYSTEM

Instrumentation grounding system is used for grounding the shields of instrumentation cables. Individual continuous shields are single point grounded which prevents circulating current flow in the shield.

Bus bars for instrumentation grounds must be insulated from enclosure and the surrounding equipment. Connection of the bus bar to the grounding electrode must be a separate connection, independent of other grounding connections and with a 600-volt insulated conductor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Damage:**			
Observation:			
a. Grounding conductor insulation damaged (less than 1/2")	EA		
***{Severity L}			
b. Grounding conductor insulation damage (more than 1/2")	LF		
***{Severity M}			
c. Grounding conductor insulation completely removed in areas.	LF		
***{Severity H}			
d. Ground bus bar electrically connected to enclosure.	EA		
***{Severity H}			

10.05 GROUNDING SYSTEM

COMPONENTS (Continued)

◆ 10.05.02 BONDING

Bonding provides an electrical connection between an electrically conductive object and a component of a lightning protection or grounding system that is intended to significantly reduce potential differences created by lightning currents. Bonding also provides electrical continuity and the capacity to conduct safely any imposed fault or static voltage induced currents.

Static electric charges and electric currents from lightning can cause stray currents to flow in tanks, tank trucks, pipelines, hose nozzles, raceways and other equipment. Such equipment must be properly bonded throughout each system and properly grounded in order to prevent such stray currents and charges from producing arcs (sparking) and causing serious personnel shocks, explosion hazards and fires.

Types of bonding methods are fusion weld, pressure connectors, and clamps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	EA		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	EA		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	EA		

Defect:

*** Physical Damage:**			
Observation:			
a. Bond cracked or chipped. ***{Severity L}	EA		
b. Improper bond material used. ***{Severity L}	EA		
c. Bond melted or burnt. ***{Severity H}	EA		
d. Loose connections. ***{Severity H}	EA		
e. Bond missing. ***{Severity H}	EA		

10.05 GROUNDING SYSTEM

REFERENCES

1. *"Handbook of Building and Plant Maintenance, Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.05 GROUNDING SYSTEM

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

N/A

10.06 RACEWAYS

DESCRIPTION

Raceways are subsystems of the Building Electrical system. Raceways support and protect those conductors that electrically interconnect equipment. Raceways, taking different forms, are classified as different systems.

There are many linear feet of raceway in an inspection area. Some of the raceway is exposed where other portions are behind walls, above ceilings and under floors. Raceways in unexposed areas are generally protected from physical damage and should not be inspected unless there is reason for an inspection. If there is a need for an inspection in this area, the inspection should be directed to the problem areas.

Exposed raceways are to be inspected in areas where they are exposed to physical damage and corrosive atmosphere. Ducts should be sealed at separation lines between areas of unlike conditions to keep fire, harmful gases and moisture from migrating from one area to the other area.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, shall be provided to perform the inspection of the subsystem:

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of raceways, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 10.06.01 BUSWAYS / BUSDUCTS
- 10.06.02 CABLE TRAYS
- 10.06.03 CONDUIT SYSTEMS
- 10.06.04 WIREWAYS
- 10.06.05 UNDERFLOOR/INFLOOR DUCT SYSTEM

RELATED SUBSYSTEMS

Due to the nature of the elements requiring inspection, no concurrent inspection activities are required.

10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

COMPONENTS

◆ 10.06.01 BUSWAYS / BUSDUCTS

Busway/Busducts are prefabricated electric distribution systems consisting of busbars in a protective enclosure, including straight lengths, fittings, devices and accessories. Busways/Busducts are of the following types:

1. Feeder Busways/Busducts are units without plug-in openings which are intended primarily for conducting electric power from the source of supply to centers of distribution but which can have provisions for bolt-on devices.

2. Plug-in Busways/Busducts are units having plug-in openings on one or both sides at spaced intervals, offering means for electrical connection of plug-in or bolt-on devices to the unit. Such plug-in or bolt-on devices may incorporate disconnect switches, circuit breakers, transformers, motor controllers, or other auxiliary equipment.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	LF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	LF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	LF		

10.06 RACEWAYS

COMPONENTS (Continued)

◆ 10.06.01 BUSWAYS / BUSDUCTS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Cover plate fastener loose or missing. ***{Severity L}	EA		
b. Gaskets out of position. ***{Severity L}	LF		
c. Ventilation obstructed. ***{Severity L}	LF		
d. Housing damaged. ***{Severity M}	LF		
e. Support loose, broken or missing. ***{Severity M}	EA		
f. End closure loose or missing. ***{Severity M}	EA		
g. Enclosure cover plate loose or missing. ***{Severity M}	EA		
h. Unused openings not covered. ***{Severity M}	EA		
i. Interior has accumulation of dust and dirt. ***{Severity M}	LF		
j. Cable Tap Box/Service head loose or missing. ***{Severity M}	EA		
k. Enclosure not grounded. ***{Severity H}	EA		
l. Interior shows signs of moisture penetration (vented only). ***{Severity H}	LF		

10.06 RACEWAYS

COMPONENTS (Continued)

◆ 10.06.02 CABLE TRAYS

Cable tray is a unit or an assembly of units or sections and associated fittings, forming a rigid structural system used to support cables and other raceways.

Typical cable trays are of the ladder, trough, channel, or solid bottom type.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	LF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	LF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	LF		

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Unit bent or bowed. ***{Severity L}	LF		
b. Fittings cracked. ***{Severity L}	EA		
c. Supports loose, broken or missing. ***{Severity L}	EA		
d. Fitting loose or missing. ***{Severity L}	EA		
e. Cover missing. ***{Severity L}	LF		
f. Ventilation obstructed. ***{Severity L}	LF		
g. Tray not grounded. ***{Severity H }	EA		

10.06 RACEWAYS

COMPONENTS (Continued)

◆ 10.06.03 CONDUIT SYSTEMS

Conduits are part of the electrical system that support and protect conductors. This system includes conduits, conduit bodies, pull boxes, junction boxes, outlet boxes and their supports.

Types of conduits commonly used are: Intermediate Metal Conduit, Rigid Metal Conduit, Rigid Nonmetallic Conduit, Electric Metallic Conduit, Flexible Metallic Tubing, Flexible Metal Conduit, Liquidtight Flexible Metal Conduit, Liquidtight Flexible Nonmetallic Conduit, Surface Metal Raceways, and Surface Nonmetallic Raceways. (Power Poles and Plugmold/wiremold are considered surface raceway.)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	LF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	LF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	LF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Conduit bent. ***{Severity L}	LF		
b. Conduit sagging. ***{Severity L}	LF		
c. Conduit support loose, broken or missing. ***{Severity L}	EA		
d. Box gasketing missing. ***{Severity L}	EA	1	
e. Box damage. ***{Severity L }	EA		
f. Box cover fastener loose or missing. ***{Severity L}	EA		
g. Box support loose, broken or missing. ***{Severity L}	EA		
h. Plugmold/wiremold support loose or missing. ***{Severity L}	EA		

10.06 RACEWAYS

COMPONENTS (Continued)

◆ 10.06.03 CONDUIT SYSTEMS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (Continued):**			
i. Unused opening not covered or plugged. ***{Severity M}	EA		
j. Cover plates missing. ***{Severity M}	EA		
k. Plugmold/wiremold damaged. ***{Severity M}	LF		
l. Conduit separation (wire exposed). ***{Severity H}	EA		
m. Conduit not bonded. ***{Severity H}	EA		

10.06 RACEWAYS

COMPONENTS (Continued)

◆ 10.06.04 WIREWAYS

Wireways are sheet-metal troughs with hinged or removable covers for housing and protecting electric wires and cables.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	LF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	LF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	LF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Gasketing missing or torn. ***{Severity L}	LF	2	
d. Supports loose, broken or missing. ***{Severity L}	EA		
e. Wireway damaged (cannot be sealed). ***{Severity M}	LF		
f. Unused openings not covered or plugged. ***{Severity M}	EA		
g. End plate missing. ***{Severity M}	EA		
h. Cover plate loose, broken or missing. ***{Severity M}	LF		
i. Unit not grounded. ***{Severity H}	EA		

10.06 RACEWAYS

COMPONENTS (Continued)

◆ 10.06.05 UNDERFLOOR/INFLOOR DUCT SYSTEM

Underfloor/Infloor duct system consists of metal raceways embedded in the concrete or included as part of the structural load-carrying floor member of the building. Metal raceways form channels for distributing cables/conductors to the end use device. Header or trenchducts connect distribution runs. Distribution runs are typically on 5′ to 6′ centers, while preset inserts are on 2 - 2-1/2′ centers to allow activation under workstations or desks. Connection is accomplished through recessed or pedestal-mounted service outlet fittings.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

	UOM		
*** Physical Damage:**			
Observation:			
a. Trench/Header Duct coverplate loose or damaged. ***{Severity L}	EA		
b. Junction box or duct insert coverplate loose. ***{Severity L}	EA		
c. Duct insert coverplate loose. ***{Severity L}	EA		
d. Service fitting housing loose or damaged. ***{Severity L}	EA		
e. Vertical elbow/duct loose. ***{Severity L}	LF		
f. Duct insert coverplate damaged or missing. ***{Severity M}	EA		
g. Trench/Header Duct coverplate missing. ***{Severity H}	EA		
h. Junction box coverplate damaged or missing. ***{Severity H}	EA		
i. Vertical elbow/single cell duct damaged or missing. ***{Severity H}	LF		

10.06 RACEWAYS

REFERENCES

1. NEMA BU1.1 - 1991 General Instructions for Proper Handling, Installation, Operation and Maintenance of Busways Rated 600 Volts or Less

2. DOE CAS Manual, Volume 9: 0.09 Electrical

3. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

4. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

10.06 RACEWAYS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.06.03-1
2	GS-II 10.06.04-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1*	GS-III 10.06.01-1

* Indicates guide sheets which are not directly referenced by a Key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: CONDUIT SYSTEMS
CONTROL NUMBER: GS-II 10.06.03-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: WIREWAYS
CONTROL NUMBER: GS-II 10.06.04-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1*

COMPONENT: BUSWAYS/BUSDUCTS
CONTROL NUMBER: GS-III 10.06.01-1*

Application

This guide applies to the inspection of Busways/Busducts at the component level. This inspection, while part of the Condition Assessment Survey, is triggered by time, age or repeated service calls.

Special Safety Requirements

Hazardous voltages in electrical equipment can cause severe personal injury or death. Turn off power to busway before performing any of the following operations. Check the voltage of all incoming line terminals to positively ascertain that the busway is totally de-energized.

Safety related work practices, as described in NFPA 70E, Part II should be followed at all times.

Inspection Actions

1. Locate Busway maintenance log book and review records concerning:

    a. Meter readings such as voltmeter, ammeter and frequency meter at input and output.

    b. Record of abnormal operations, failures, and corrective actions taken.

    c. Maintenance history.

    This log should be used for comparison to defect changes and degradation of the Busway.

2. Refer to NEMA BU1.1, latest addition *"General Instruction for Proper Handling, Installation, Operation and Maintenance of Busway Rated 600V or Less"*, for recommended checkout procedures.

3. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1* (Continued)

COMPONENT: BUSWAYS/BUSDUCTS
CONTROL NUMBER: GS-III 10.06.01-1*

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67
2. Infrared scanner, Raytek Inc., #PM2EM-12
3. Torque wrench
4. Refer to manufacturer maintenance guide for additional special tools required

Recommended Inspection Frequency

1. Inspect busway once each three years or after any severe electrical short circuit or ground fault.

References

1. NEMA BU1.1-1991, *"General Instructions for Proper Handling, Installation, Operation and Maintenance of Busway Rated 600 Volts or Less"*

10.07 POWER SOURCES

DESCRIPTION

Power sources are a subsystem of the Building Electrical System. Power sources can provide prime or standby power when the preferred power supply is not available. Power sources are also used to convert or condition the preferred power source's voltage or frequency to serve a system or equipment.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, shall be provided to perform the inspection of power sources:

1. Infrared scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of power sources, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.07.01 BATTERY RACKS
- ◆ 10.07.02 BATTERY CHARGERS
- ◆ 10.07.03 BATTERY, STORAGE
- ◆ 10.07.04 MOTOR-GENERATOR SETS
- ◆ 10.07.05 SOLID STATE FREQUENCY CONVERTERS
- ◆ 10.07.06 SOLID STATE UNINTERRUPTIBLE POWER SUPPLY
- ◆ 10.07.07 SOLID STATE POWER CONDITIONERS
- ◆ 10.07.08 ENGINE-GENERATORS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM < 600V
10.10 PANELBOARDS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.07 POWER SOURCES

COMPONENTS

◆ 10.07.01 BATTERY RACKS

Battery racks provide means to support, secure, and arrange batteries where multiple batteries are required to meet system requirements.

Battery racks are typically used in commercial and industrial installations and are of the single tier, multiple tier, or enclosed type, constructed of wood or metal.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Rack mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fasteners loose, broken or missing. ***{Severity L}	EA		
c. Rack or enclosure inaccessible. ***{Severity L}	EA		
d. Rack bent or broken. ***{Severity M}	LF		
e. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
f. Rack or enclosure not grounded. ***{Severity H }	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.02 BATTERY CHARGERS

This CAIS applies to fixed battery chargers. Battery Chargers are fully automatic, constant voltage, rectifier type that regulates the output current to meet the demand of batteries or loads. Battery chargers are used in utility applications, engine starting, vehicle changing stations, switchyards, railroad service, etc.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		
Defect:			
*** Physical Damage:**			
Observation:			
a. Pilot light damaged or inoperative. ***{Severity L}	EA		
b. Switch or pushbutton damaged or broken. ***{Severity L}	EA		
c. Panel fastener loose, broken or missing. ***{Severity L}	EA		
d. Interior not clean and moisture free. ***{Severity L}	EA	1	
e. Air filter dirty or missing. ***{Severity L}	EA	1	
f. Noisy unit. ***{Severity L}	EA		
g. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
h. Cable insulation damaged or carbon-tracked. ***{Severity M}	LF	1	

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.02 BATTERY CHARGERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (Continued):**			
i. Rectifier discolored or blistered due to overheating. ***{Severity M}	EA	1	
j. Transformer discolored or blistered due to overheating. ***{Severity M}	EA	1	
k. Unused opening not covered. ***{Severity M}	EA		
l. Ventilation obstructed. ***{Severity M}	EA		
m. Unit not grounded. ***{Severity H }	EA	1	
n. Meter damaged or broken. ***{Severity M}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal connection 5° to 24° C above ambient. ***{Severity M}	EA	2	1
b. Terminal connection 25°C or more above ambient. ***{Severity H}	EA	2	1

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.03 BATTERY, STORAGE

This CAIS applies to fixed battery (storage). A battery consists of a group of cells (electrochemical couple) connected in a combination of series and parallel to provide a specified terminal voltage and ampere-hour capacity.

Batteries typically used in commercial and industrial applications are either Lead-Acid or Nickel Cadmium type which are sealed or vented.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Damage:**			
Observation:			
a. Corroded or loose connector. ***{Severity L}	EA		
b. Loose connector. ***{Severity L}	EA		
c. Loose mounting. ***{Severity L}	EA		
d. Battery case not clean. ***{Severity L}	EA		
e. Liquid leakage. ***{Severity M}	EA		
f. Improper liquid level. ***{Severity M}	EA	3	
g. Cracked or broken connector. ***{Severity M}	EA		
h. Battery cable damaged. ***{Severity M}	LF		
i. Cracked case. ***{Severity H}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.04 MOTOR-GENERATOR SETS

This CAIS applies to fixed motor-generators. Motor-generators convert one form of electrical power to another form of electrical power. Unit consist of an electric motor, fed from one power source, that drives a generator which produces another power source of different characteristics.

Inspection is to cover both the mechanical and electrical parts of the motor-generators.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Panel fastener loose, broken or missing. ***{Severity L}	EA		
b. Enclosure damaged. ***{Severity M}	EA		
c. Unused opening not covered. ***{Severity M}	EA		
d. Unit not grounded. ***{Severity H}	EA	4	
e. Unit mounting loose, broken or missing. ***{Severity L}	EA		
f. Readout device or meter loose or damaged. ***{Severity M}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.04 MOTOR-GENERATOR SETS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Operation:**			
Observation:			
a. Unit overloaded 10 to 15%. ***{Severity L}	EA		
b. Excessive unit noise or vibration. ***{Severity M}	EA		2
c. Unit overloaded 16 to 25%. ***{Severity M}	EA		22
d. Excessive sparking at the collector rings, commutator or brushes. ***{Severity M}	EA		3
e. Unit overloaded more than 25%. ***{Severity H}	EA		22

Defect:

*** Operating Temperature:**			
Observation:			
a. Generator ventilating screens and air passages clogged. ***{Severity H}	EA		
b. Electric motor ventilating screens and air passage clogged. ***{Severity H}	EA		

Defect:

*** Housekeeping:**			
Observation:			
a. Motor housings contaminated. ***{Severity L}	EA		
b. Machine air passage dirty or clogged. ***{Severity M}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.04 MOTOR-GENERATOR SETS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Structure:**			
Observation:			
a. Motor frame cracked or broken. ***{Severity M}	EA		
b. Motor support cracked or broken. ***{Severity M}	EA		
c. Motor support shifted. ***{Severity M}	EA		
d. Defective mounting pads. ***{Severity M}	EA		
e. Loose or missing mounting bolts. ***{Severity H}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Power Connections:**			
Observation:			
a. Terminal box cover missing. ***{Severity L}	EA		
b. Insulation of motor leads damaged or deteriorated. ***{Severity M}	EA	4	
c. Taping improperly installed or deteriorated. ***{Severity M}	EA	4	

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	5	4
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	5	4

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.05 SOLID STATE FREQUENCY CONVERTERS

This CAIS applies to fixed solid-state frequency converters. Solid State Converters convert incoming power to the frequency and voltage level required by the end use device.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Pilot light damaged or inoperative. ***{Severity L}	EA		
b. Switch or pushbutton damaged or broken. ***{Severity L}	EA		
c. Panel fastener loose, broken or missing. ***{Severity L}	EA		
d. Ventilation obstructed. ***{Severity L}	LF		
e. Noisy unit. ***{Severity L}	EA		
f. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
g. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
h. Cable insulation damaged or carbon-tracked. ***{Severity M}	LF	6	
i. Unused openings not covered. ***{Severity M}	EA		
j. Unit not grounded. ***{Severity H }	EA	6	
k. Readout device or meter loose or damaged. ***{Severity L}	EA		
l. Air filter dirty or missing. ***{Severity M}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.05 SOLID STATE FREQUENCY CONVERTERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal connection 5° to 24°C above ambient. ***{Severity M}	EA	7	5
b. Terminal connection 25°C or more above ambient. ***{Severity H}	EA	7	5

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	13	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	13	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	13	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	13	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	13	19
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	13	19
g. Load current more than 2% above FLC. ***{Severity H}	EA	13	19

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.06 SOLID STATE UNINTERRUPTIBLE POWER SUPPLY (UPS)

This CAIS applies to fixed solid state uniterruptible power supply. Solid State Uninterruptible Power Supply operates in conjunction with the facility power distribution system to provide high quality power to critical electrical equipment when facility power is on line and during an orderly shutdown period immediately after facility power fails.

The UPS consist of a solid state inverter, rectifier/battery charger, storage battery, static transfer switch and bypass circuit breaker.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	EA		

Defect:

*** Physical Damage:**			
Observation:			
a. Pilot light damaged or inoperative. ***{Severity L}	EA		
b. Switch or pushbutton broken or missing. ***{Severity L}	EA		
c. Panel fastener loose, broken or missing. ***{Severity L}	EA		
d. Air filter dirty or missing. ***{Severity L}	EA	8	
e. Ventilation obstructed. ***{Severity L}	LF		
f. Noisy unit. ***{Severity L}	EA		
g. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
h. Cable insulation damaged or carbon-tracked. ***{Severity M}	LF	8	
i. Unused opening not covered or plugged. ***{Severity M}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ **10.07.06 SOLID STATE UNINTERRUPTIBLE POWER SUPPLY (UPS) (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (Continued):**			
j. Readout device or meter loose or damaged. ***{Severity M}	EA		
k. Air exhaust fans inoperative. ***{Severity M}	EA	8	
l. Unit not grounded. ***{Severity H}	EA	8	
m. Readout device or meter loose or damaged. ***{Severity L}	EA		

Defect:			
*** Hot Spots:**			
Observation:			
a. Terminal connection 5° to 24°C above ambient. ***{Severity M}	EA	9	6
b. Terminal connection 25°C or more above ambient. ***{Severity H}	EA	9	6

Defect:			
*** Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	14	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	14	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	14	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	14	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	14	20
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	14	20
g. Load current more than 2% above FLC. ***{Severity H}	EA	14	20

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.07 SOLID STATE POWER CONDITIONERS

This CAIS applies to fixed solid-state power conditioners. Solid State Power Conditioner operates in conjunction with the power distribution system to provide voltage regulation and noise isolation to critical electrical equipment whenever incoming power is of poor quality.

Power Conditioners may include integral conditioner/isolation and transfer switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Pilot light damaged or inoperative. ***{Severity L}	EA		
b. Switch or pushbutton broken or missing. ***{Severity L}	EA		
c. Panel fastener loose, broken or missing. ***{Severity L}	EA		
d. Ventilation obstructed. ***{Severity M}	LF		
e. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
f. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
g. Cable insulation damaged or carbon-tracked. ***{Severity M}	LF	10	
h. Unused openings not covered. ***{Severity M}	EA		
i. Unit not grounded. ***{Severity H}	EA	10	
j. Readout device or meter loose or damaged. ***{Severity L}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.07 SOLID STATE POWER CONDITIONERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal connection 5° to 24°C above ambient. ***{Severity M}	EA	11	7
b. Terminal connection 25°C or more above ambient. ***{Severity H}	EA	11	7

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	15	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	15	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	15	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	15	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	15	21
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	15	21
g. Load current more than 2% above FLC. ***{Severity H}	EA	15	21

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.08 ENGINE-GENERATORS

This CAIS applies to fixed engine-generators. Engine-generators convert fuel into electrical power. Each unit consist of a engine and generator working together as a unit. Since the two pieces of equipment work together as a unit, the inspection will cover both mechanical and electrical components.

Engine-generators are used as primary or secondary power services and require the same inspection.

Engine-generator, if not operating, should be started up and run during the Level I and II inspection. No loads need to be applied to the engine-generator during these two level of inspections.

Control panel, circuit breaker, bonding and end use device connections will be inspected under separate components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Records Not in Order:**			
Observation:			
a. Oil changes not on schedule. ***{Severity L}	EA		
b. Oil change record missing. ***{Severity H}	EA		
c. Oil analysis report incomplete or missing. ***{Severity H}	EA		

Defect:

*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.08 ENGINE-GENERATORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaks:**			
Observation:			
a. Coolant on surface of equipment (possible coolant leak). ***{Severity L}	EA		
b. Oil on surface of engine (possible oil leak). ***{Severity M}	EA		
c. Coolant under or around base of engine. ***{Severity H}	EA		
d. Oil puddle under or around base of engine. ***{Severity H}	EA		

Defect:

*** Regulations:**			
Observation:			
a. Speed regulation, plus/minus 1/2% to 1%. ***{Severity L}	EA		
b. Voltage regulation, plus/minus 1/2% to 1%. ***{Severity L}	EA		
c. Speed regulation, plus/minus 1% to 3%. ***{Severity M}	EA		
d. Voltage regulation, plus/minus 1% to 3%. ***{Severity M}	EA		
e. Speed regulation, plus/minus 3% or greater. ***{Severity H}	EA		8
f. Voltage regulation, plus/minus 3% or greater. ***{Severity H}	EA		9

Defect:

*** Operating Temperature:**			
Observation:			
a. Engine 10°F or less above normal. ***{Severity M}	EA		
b. Engine greater than 10°F above normal. ***{Severity H}	EA		
c. Generator ventilating screens and air passages clogged. ***{Severity H}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.08 ENGINE-GENERATORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Radiator System:**			
Observation:			
a. Shutters stick open. ***{Severity L}	EA		
b. Radiator shroud damaged or loose. ***{Severity L}	EA		
c. Shutter screen dirty or clogged. ***{Severity M}	EA		
d. Radiator assembly damaged. ***{Severity M}	EA		
e. Shutters stick close. ***{Severity H}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Improper Engine Operation:**			
Observation:			
a. Excessively noisy. ***{Severity M}	EA		10
b. Excessive vibration. ***{Severity M}	EA		10
c. Cylinder missing. ***{Severity M}	EA		10

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Belts and Hoses:**			
Observation:			
a. Hose end cracked. ***{Severity H}	EA		
b. Belt cracked or torn. ***{Severity H}	EA		

10.07 POWER SOURCES

COMPONENTS (Continued)

◆ 10.07.08 ENGINE-GENERATORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Exhaust System:**			
Observation:			
a. Rain cap missing. ***{Severity L}	EA		
b. Heat shield missing. ***{Severity L}	EA		
c. Muffler/pipe supports loose. ***{Severity M}	EA		
d. Muffler/pipe supports broken or missing. ***{Severity M}	EA		
e. Holes in muffler/exhaust pipe. ***{Severity H}	EA		

Defect:

*** Enclosure:**			
Observation:			
a. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
b. Enclosure not grounded. ***{Severity H}	EA		

Defect:

*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	12	11
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	12	11

10.07 POWER SOURCES

REFERENCES

1. Army TB 420-34, NAVFAC P-717.0, Air Force Manual 85-59 - Preventive/Recurring Maintenance Handbook

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.07 POWER SOURCES

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.07.02-1
2	GS-II 10.07.02-2
3	GS-II 10.07.03-3
4	GS-II 10.07.04-4
5	GS-II 10.07.04-5
6	GS-II 10.07.05-6
7	GS-II 10.07.05-7
8	GS-II 10.07.06-8
9	GS-II 10.07.06-9
10	GS-II 10.07.07-10
11	GS-II 10.07.07-11
12	GS-II 10.07.08-12
13	GS-II 10.07.05-13
14	GS-II 10.07.06-14
15	GS-II 10.07.07-15

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.07.02-1
2	GS-III 10.07.04-2
3	GS-III 10.07.04-3
4	GS-III 10.07.04-4
5	GS-III 10.07.05-5
6	GS-III 10.07.06-6
7	GS-III 10.07.07-7
8	GS-III 10.07.08-8
9	GS-III 10.07.08-9
10	GS-III 10.07.08-10
11	GS-III 10.07.08-11
12*	GS-III 10.07.04-12
13*	GS-III 10.07.04-13
14*	GS-III 10.07.05-14
15*	GS-III 10.07.06-15
16*	GS-III 10.07.07-16
17*	GS-III 10.07.08-17
18*	GS-III 10.07.08-18
19	GS-III 10.07.05-19
20	GS-III 10.07.06-20
21	GS-III 10.07.07-21
22	GS-III 10.07.04-22

* Indicates guide sheets which are not directly referenced by a key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BATTERY CHARGERS
CONTROL NUMBER: GS-II 10.07.02-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: BATTERY CHARGERS
CONTROL NUMBER: GS-II 10.07.02-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: BATTERY CHARGERS
CONTROL NUMBER: GS-II 10.07.02-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: BATTERY, STORAGE
CONTROL NUMBER: GS-II 10.07.03-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: MOTOR-GENERATOR SETS
CONTROL NUMBER: GS-II 10.07.04-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: MOTOR-GENERATOR SETS
CONTROL NUMBER: GS-II 10.07.04-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: MOTOR-GENERATOR SETS
CONTROL NUMBER: GS-II 10.07.04-5

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6

COMPONENT: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-II 10.07.05-6

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7

COMPONENT: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-II 10.07.05-7

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-II 10.07.05-7

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8

COMPONENT: SOLID STATE UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-II 10.07.06-8

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9

COMPONENT: SOLID STATE UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-II 10.07.06-9

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: SOLID STATE UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-II 10.07.06-9

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 10

COMPONENT: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-II 10.07.07-10

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11

COMPONENT: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-II 10.07.07-11

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11 (Continued)

COMPONENT: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-II 10.07.07-11

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 12

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-II 10.07.08-12

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 12 (Continued)

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-II 10.07.08-12

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 13

COMPONENT: S.S. FREQUENCY CONVERTER
CONTROL NUMBER: GS-II 10.07.05-13

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.

3. A Level II Help Screen Chart will convert readings to percentages by observation.

4. Close panels or doors carefully after the inspection is completed.

5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 13

COMPONENT: S.S. FREQUENCY CONVERTER
CONTROL NUMBER: GS-II 10.07.05-13

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\%\ \text{Overload} = \frac{(\text{Measured Current} - \text{Full Load Current})\ \text{Times}\ 100}{\text{Full Load Current}}$$

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 14

COMPONENT: S.S. UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-II 10.07.06-14

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.

3. A Level II Help Screen Chart will convert readings to percentages by observation.

4. Close panels or doors carefully after the inspection is completed.

5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 14

COMPONENT: S.S. UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-II 10.07.06-14

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\% \text{ Overload} = \frac{(\text{Measured Current} - \text{Full Load Current}) \text{ Times } 100}{\text{Full Load Current}}$$

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 15

COMPONENT: S.S. POWER CONDITIONER
CONTROL NUMBER: GS-II 10.07.07-15

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.

3. A Level II Help Screen Chart will convert readings to percentages by observation.

4. Close panels or doors carefully after the inspection is completed.

5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 15

COMPONENT: S.S. POWER CONDITIONER
CONTROL NUMBER: GS-II 10.07.07-15

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\%\ \text{Overload} = \frac{(\text{Measured Current} - \text{Full Load Current})\ \text{Times}\ 100}{\text{Full Load Current}}$$

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: BATTERY CHARGERS
CONTROL NUMBER: GS-III 10.07.02-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: BATTERY CHARGERS
CONTROL NUMBER: GS-III 10.07.02-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTOR-GENERATOR SETS
CONTROL NUMBER: GS-III 10.07.04-2

Application

This guide applies to the investigation of generator sets that have excessive noise or vibration symptoms.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by using the vibration/sound level meter and measure the velocity (inches/second, peak), displacement (mils, peak-peak) and noise (db). Compare reading with acceptable manufacturer tolerances.

2. Inspect bearings for defects or dryness.

3. Inspect generator and prime mover for misalignment.

4. Inspect generator and prime mover for proper mounting.

5. Inspect generator and prime mover for transfer of vibration from another source.

6. If none of the above is the problem, reference manufacturer troubleshooting guide for additional inspections or repairs to be made.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Vibration/sound level meter, IRD Mechanalysis #1TC87

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. KATO Engineering, Instruction Manual for Brushless Revolving Field Alternating Current Generators

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTOR-GENERATOR SET
CONTROL NUMBER: GS-III 10.07.04-3

Application

This guide applies to the investigation of excessive sparking at the collector rings, commutator or brushes.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Level I Inspector will detect excessive sparking in the area of either the collector rings, commutator or brushes. Level III Inspector will perform the following tasks.

1. Verify that there is excessive sparking in the area of either the collector rings, commutator or brushes.

2. If there is a problem, stop the motor and evaluate the problems causing the sparking.

3. Classify the severity of the problem and recommend the procedure needed to correct the problem.

4. If the Level III Inspector can not evaluate the problem, recommend the next procedure required to further identify the correction procedure that needs to be followed.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Wrenches

2. Feelers

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. *"Handbook of Building and Plant Maintenance, Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: MOTOR-GENERATOR SET
CONTROL NUMBER: GS-III 10.07.04-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: **MOTOR-GENERATOR SET**
CONTROL NUMBER: GS-III 10.07.04-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-III 10.07.05-5

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-III 10.07.05-5

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: SOLID STATE UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-III 10.07.06-6

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: SOLID STATE UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-III 10.07.06-6

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-III 10.07.07-7

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-III 10.07.07-7

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-8

Application

This guide applies to the investigation of generator sets that have over and under speed symptoms.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by observing the overspeed.

2. Refer to the manufacturer troubleshooting guide for testing and check-out procedures.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer troubleshooting guide for special tools required.

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Caterpillar *"Operation and Maintenance Manual"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-9

Application

This guide applies to the investigation of generator sets that have over and under voltage symptoms.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by observing voltage meter on unit and by using independent voltage meter.

2. Inspect units voltage meter accuracy against independent voltage meter.

3. Inspect voltage regulator rheostat for proper adjustment settings or defects.

4. Inspect connections for high resistance using the infrared scanner inspection method.

5. Inspect bearings for defects or dryness.

6. Verify proper input voltage and/or frequency of incoming power when generator set is motor driven or engine governor on engine driven generator sets.

7. Verify generator set is not loaded above nameplate rating.

8. If none of the above is the problem, reference manufacturer troubleshooting guide for additional inspections or repairs to be made.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-9

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67

2. Infrared Scanner, Raytek Inc., #PM2EM-L2

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. KATO Engineering, Instruction Manual for Brushless Revolving Field Alternating Current Generators

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-10

Application

This guide applies to the investigation of generator sets that have excessive noise or vibration symptoms.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by using the vibration/sound level meter and measure the velocity (inches/second, peak), displacement (mils, peak-peak) and noise (db). Compare reading with acceptable manufacturer tolerances.

2. Inspect bearings for defects or dryness.

3. Inspect generator and prime mover for misalignment.

4. Inspect generator and prime mover for proper mounting.

5. Inspect generator and prime mover for transfer of vibration from another source.

6. If none of the above is the problem, reference manufacturer troubleshooting guide for additional inspections or repairs to be made.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Vibration/sound level meter, IRD Mechanalysis #1TC87

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. KATO Engineering, Instruction Manual for Brushless Revolving Field Alternating Current Generators

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-11

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11 (Continued)

COMPONENT: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.8-11

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12*

SUBSYSTEM: MOTOR - GENERATOR SETS
CONTROL NUMBER: GS-III 10.07.04-12*

Application

This guide applies to the need for certain system inspection and tests that may be necessary to fully determine the operating condition of a motor-generator set. These tests should be performed at certain intervals during its design life.

Special Safety Requirements

No safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate motor-generator set maintenance log book and review records concerning:

    a. System operation normal settings and adjustments.

    b. Meter readings such as voltmeter, ammeter and frequency meter at input and output.

    c. Record of abnormal operations, failures, and corrective actions taken.

    d. Maintenance history.

    This log should be used for comparison to defect changes and degradation of the motor-generator set, need for adjustment of controls, or other maintenance and testing.

2. Inspect motor-generator sets per manufacturers recommendations. If no inspection procedures are recommended the following shall be used.

3. Refer to NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"*, for recommended testing procedures.

4. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12* (Continued)

SUBSYSTEM: MOTOR - GENERATOR SETS
CONTROL NUMBER: GS-III 10.07.04-12*

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required.

Recommended Inspection Frequency

1. Perform test when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks.

2. Perform tests on a three year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"* 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13*

COMPONENT: ELECTRIC MOTOR & GENERATOR 93,
CONTROL NUMBER: GS-III 10.07.04-13*

Application

This guide applies to the inspection of electric motor and generator windings at the component level. This inspection, while part of the Condition Assessment Survey, is triggered by time, age or repeated service calls.

Special Safety Requirements

Hazardous voltages in electrical equipment can cause severe personal injury or death. Turn off power to motor before performing any of the following operations. Check the voltage of all incoming line terminals to positively ascertain that the motor is totally de-energized.

Safety related work practices, as described in NFPA 70E, Part II should be followed at all times.

Inspection Actions

1. Locate motor maintenance log book and review records concerning:

   a. Meter readings such as voltmeter, ammeter and frequency meter at input.

   b. Record of abnormal operations, failures, and corrective actions taken.

   c. Maintenance history.

   This log should be used for comparison to defect changes and degradation of the motor windings.

2. Check motor windings for heavy accumulation of dust, dirt, moisture, oil and grease.

3. Check winding tightness in the slots or on the pole pieces.

4. Check insulation surfaces for cracks, crazing, flacking or powdering.

5. Check the winding mechanical supports for insulation quality and tightness, the ring binding on stator windings and the glass or wire-wound bands on rotating windings.

6. Examine squirrel-cage rotors for excessive heating, or for discolored or cracked rotor bars or cracked end rings.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13* (Continued)

COMPONENT: ELECTRICAL MOTOR
CONTROL NUMBER: GS-III 10.07.04-13*

Inspection Actions (Continued)

7. Perform insulating resistance testing.

8. Refer to NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"* for recommended testing procedures.

9. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Analog Megohmmeter, Biddle #210801-3CL
2. Digital Multimeter, Fluke #1TC67
3. Torque wrench
4. Refer to manufacturer maintenance troubleshooting guide for additional special tools required

Recommended Inspection Frequency

1. Inspect motor windings once each three years or after any severe electrical short circuit.

References

1. NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14*

SUBSYSTEM: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-III 10.07.05-14*

Application

This guide applies to the need for certain system tests that may be necessary to fully determine the operating condition of a Frequency Converter system. These tests should be performed when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks, or at certain intervals during its design life.

Special Safety Requirements

No safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate Frequency Converter maintenance log book and review records concerning:

   a. System operation normal settings and adjustments.

   b. Meter readings such as voltmeter, ammeter and frequency meter at input and output.

   c. Record of abnormal operations, failures, and corrective actions taken.

   d. Maintenance history.

   This log should be used for comparison to defect changes and degradation of the Frequency Converter circuitry, need for adjustment of controls, or other maintenance and testing.

2. Refer to "Manufacturer Troubleshooting Guide" for recommended testing procedures.

3. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14* (Continued)

SUBSYSTEM: SOLID STATE FREQUENCY CONVERTERS
CONTROL NUMBER: GS-III 10.07.05-14*

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required.

Recommended Inspection Frequency

1. Perform test when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks.

2. Perform tests on a three year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. Manufacturer Maintenance Literature

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15*

SUBSYSTEM: SOLID STATE UNINTERRUPTABLE POWER SUPPLY
CONTROL NUMBER: GS-III 10.07.06-15*

Application

This guide applies to the need for certain system tests that may be necessary to fully determine the operating condition of a UPS system. These tests should be performed when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks, or at certain intervals during its design life.

Special Safety Requirements

No safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate UPS maintenance log book and review records concerning:

   a. System operation normal settings and adjustments.

   b. Meter readings such as voltmeter, ammeter and frequency meter at input and output.

   c. Record of abnormal operations, failures, and corrective actions taken.

   d. Maintenance history.

   This log should be used for comparison to defect changes and degradation of the UPS circuitry, need for adjustment of controls, or other maintenance and testing.

2. Refer to NFPA 70B "Recommended Practice for Electrical Equipment Maintenance", for recommended testing procedures.

3. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15* (Continued)

SUBSYSTEM: SOLID STATE UNINTERRUPTABLE POWER SUPPLY
CONTROL NUMBER: GS-III 10.07.06-15*

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required.

Recommended Inspection Frequency

1. Perform test when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks.

2. Perform tests on a three year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"* 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 16*

SUBSYSTEM: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-III 10.07.07-16*

Application

This guide applies to the need for certain system tests that may be necessary to fully determine the operating condition of a Power Conditioner system. These tests should be performed when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks, or at certain intervals during its design life.

Special Safety Requirements

No safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate Power Conditioner maintenance log book and review records concerning:

   a. System operation normal settings and adjustments.

   b. Meter readings such as voltmeter, ammeter and frequency meter at input and output.

   c. Record of abnormal operations, failures, and corrective actions taken.

   d. Maintenance history.

   This log should be used for comparison to defect changes and degradation of the Power Conditioner circuitry, need for adjustment of controls, or other maintenance and testing.

2. Refer to "Manufacturer Troubleshooting Guide" for recommended testing procedures.

3. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 16* (Continued)

SUBSYSTEM: SOLID STATE POWER CONDITIONERS
CONTROL NUMBER: GS-III 10.07.07-16*

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required.

Recommended Inspection Frequency

1. Perform test when warranted by special circumstances, such as repeated failure of a system to pass routine maintenance checks.

2. Perform tests on a three year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. Manufacturer Maintenance Literature

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 17*

SUBSYSTEM: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-17*

Application

This guide applies to the need for certain system inspections that may be necessary to fully determine the operating condition of engine-generator sets. These inspections should be performed at certain intervals during its design life.

Special Safety Requirements

No safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate engine-generator set maintenance log book and review records concerning:

    a. System operation normal settings and adjustments.

    b. Meter readings such as voltmeter, ammeter and frequency meter at input and output.

    c. Record of abnormal operations, failures, and corrective actions taken.

    d. Maintenance history.

    This log should be used for comparison to defect changes and degradation of the engine-generator set, need for adjustment of controls, or other maintenance and testing.

2. Inspect engine-generator sets per manufacturers recommendations. If no inspection procedures are recommended the following shall be used.

3. Before starting the engine:

    a. Do a walk-around inspection and check the engine, radiator, and generator for debris, foreign objects, loose or broken fittings, guards, and components.

    b. Inspect cooling system for leaks.

    c. Inspect fuel system for water and sediment from tank.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 17* (Continued)

SUBSYSTEM: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-17*

Inspection Actions (Continued)

d. Inspect air cleaner element.

e. Inspect engine crankcase oil and breather.

f. Inspect and test linkage for proper operation.

g. Inspect and test alarms and shutdown devices for proper operation.

h. Inspect generator bearings and wiring of regulator, exciter, and stator.

i. Check generator windings with megohmmeter and record reading for reference.

4. With engine running:

a. Inspect all gauges, oil pressure, fuel pressure, rpm (frequency), generator voltage and engine jacket water temperature for proper readings.

b. Inspect radiator louvers for proper operation.

c. Inspect unit for leaks and unusual noises.

d. Load test engine to minimum of 30% of rated load. Operate at this level for minimum of two hours.

e. Inspect all gauges, oil pressure, fuel pressure, rpm (frequency), generator voltage, service meter, engine water jacket water temperature, exhaust temperature (if equipped), and manifold vacuum (if equipped) for proper readings.

5. After stopping the engine:

a. Note any repairs or adjustments required to the engine and generator.

6. Testing and inspection should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 17* (Continued)

SUBSYSTEM: ENGINE-GENERATORS
CONTROL NUMBER: GS-III 10.07.08-17*

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Analog Megohmmeters, Biddle #210801-3CL.

2. See manufacturer maintenance guide for additional tools required.

Recommended Inspection Frequency

1. Perform inspections and tests on a three year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"* 1990 Edition

2. Caterpillar *"Operation and Maintenance Manual"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 18*

COMPONENT: ELECTRIC MOTOR
CONTROL NUMBER: GS-III 10.07.08-18*

Application

This guide applies to the inspection of electric motor windings at the component level. This inspection, while part of the Condition Assessment Survey, is triggered by time, age or repeated service calls.

Special Safety Requirements

Hazardous voltages in electrical equipment can cause severe personal injury or death. Turn off power to motor before performing any of the following operations. Check the voltage of all incoming line terminals to positively ascertain that the motor is totally de-energized.

Safety related work practices, as described in NFPA 70E, Part II should be followed at all times.

Inspection Actions

1. Locate motor maintenance log book and review records concerning:

   a. Meter readings such as voltmeter, ammeter and frequency meter at input.

   b. Record of abnormal operations, failures, and corrective actions taken.

   c. Maintenance history.

   This log should be used for comparison to defect changes and degradation of the motor windings.

2. Check motor windings for heavy accumulation of dust, dirt, moisture, oil and grease.

3. Check winding tightness in the slots or on the pole pieces.

4. Check insulation surfaces for cracks, crazing, flacking or powdering.

5. Check the winding mechanical supports for insulation quality and tightness, the ring binding on stator windings and the glass or wire-wound bands on rotating windings.

6. Examine squirrel-cage rotors for excessive heating, or for discolored or cracked rotor bars or cracked end rings.

7. Perform insulating resistance testing.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 18* (Continued)

COMPONENT: ELECTRICAL MOTOR
CONTROL NUMBER: GS-III 10.07.08-18*

Inspection Actions (Continued)

8. Refer to NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"* for recommended testing procedures.

9. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer recommendations, specifications, tolerances, and safety precautions.

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Analog Megohmmeter, Biddle #210801-3CL
2. Digital Multimeter, Fluke #1TC67
3. Torque wrench
4. Refer to manufacturer maintenance troubleshooting guide for additional special tools required

Recommended Inspection Frequency

1. Inspect motor windings once each three years or after any severe electrical short circuit.

References

1. NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 19

COMPONENT: S.S. FREQUENCY CONVERTER
CONTROL NUMBER: GS-III 10.07.05-19

Application

This guide applies to the investigation of S.S. frequency converters that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the S.S. frequency converter.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter

2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 20

COMPONENT: S.S. UNINTERRUPTIBLE POWER SUPPLY
CONTROL NUMBER: GS-III 10.07.06-20

Application

This guide applies to the investigation of S.S. uninterruptible power supply that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the S.S. uninterruptible power supply.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter
2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 21

COMPONENT: S.S. POWER CONDITIONER
CONTROL NUMBER: GS-III 10.07.07-21

Application

This guide applies to the investigation of S.S. power conditioners that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the S.S. power conditioner.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter
2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 22

SUBSYSTEM: MOTOR - GENERATOR SETS
CONTROL NUMBER: GS-III 10.07.04-22

Application

This guide applies to the need for certain system inspection and tests that may be necessary to fully determine the operating condition of a motor-generator set, where overload conditions are observed.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate motor-generator set Level I survey data along with its maintenance log book and review records concerning:

   a. System operation normal settings and adjustments.

   b. Meter readings such as voltmeter, ammeter and frequency meter at input and output, which indicate overload condition.

   c. Record of previous abnormal operations, failures, and corrective actions taken.

   d. Maintenance history.

   e. Analyze power circuits supplied for increased or added new loads. Note same if appropriate.

   f. Write report to Facility Manager listing causes of overload conditions and proposed corrective action with an estimate of costs required.

   This log and survey data should be used for comparison of defect changes and degradation of the motor-generator set, need for adjustment of controls, or other maintenance and testing.

2. Inspect motor-generator sets per manufacturers recommendations for overload conditions. If no inspection procedures are recommended the following shall be used.

3. Refer to NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"*, for recommended testing procedures.

4. Testing should not be attempted unless those performing this work indicated above are completely familiar with the manufacturer's recommendations, specifications, tolerances, and safety precautions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 22 (Continued)

SUBSYSTEM: MOTOR - GENERATOR SETS
CONTROL NUMBER: GS-III 10.07.04-22

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required.

Recommended Inspection Frequency

1. When triggered by a Level I inspection

References

1. NFPA 70B *"Recommended Practice for Electrical Equipment Maintenance"* 1990 Edition

10.08 MOTOR CONTROL CENTERS (MCC)

DESCRIPTION

Motor Control Centers (MCC) are subsystems of the Building Electrical System. Motor Control Centers are electrical units designed to house devices for the purpose of switching and protecting a number of load circuits. This is accomplished in the form of free-standing single or multi units and are used for the control of HVAC, Plumbing, Fire Protection and miscellaneous building motor requirements.

Components consist mainly of an enclosure containing bus bars, feeder circuit breakers or fusible switches, motor starters/contactors, transformers, transfer switches and control stations.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tool, beyond the requirements listed in the Standard Tool Section shall be provided to perform the inspection of the Motor Control Center (MCC):

1. Infrared scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Motor Control Center (MCC) beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.08.01 ENCLOSURES WITH BUS BARS
- ◆ 10.08.02 CIRCUIT BREAKERS (LOW VOLTAGE)
- ◆ 10.08.03 DISCONNECT SWITCHES (LOW VOLTAGE)
- ◆ 10.08.04 MOTOR STARTERS/CONTACTORS
- ◆ 10.08.05 TRANSFORMERS
- ◆ 10.08.06 TRANSFER SWITCHES

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.04 POWER CONTROL
10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS

◆ 10.08.01 ENCLOSURES WITH BUS BARS

Enclosures with bus bars, their connections and structural steel that make up the enclosure, for motor control centers, panelboards, switchboards, switchyard and substations, includes doors and panels that are not part of any equipment mounted in the enclosure. Doors and panels not included in the enclosure inspection are those for circuit breakers, disconnect switches, combination starters, etc. which would be inspected as part of those components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Panel fastener loose, broken or missing. ***{Severity L}	EA		
b. Excessive dust, dirt or moisture accumulation. ***{Severity L}	EA	1	
c. Enclosure mounting loose broken or missing. ***{Severity M}	EA		
d. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Vent opening blocked. ***{Severity M}	EA		
g. Air filters dirty or missing. ***{Severity M}	EA	1	
h. Unit not grounded. ***{Severity H}	EA	1	

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.01 ENCLOSURES WITH BUS BARS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Bus connection 5° to 24°C above ambient. ***{Severity M}	EA	2	1
b. Bus connection 25°C or more above ambient. ***{Severity H}	EA	2	1

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	12	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	12	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	12	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	12	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	12	8
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	12	8
g. Load current more than 2% above FLC. ***{Severity H}	EA	12	8

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.02 CIRCUIT BREAKERS (LOW VOLTAGE)

Circuit breakers (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. They contain built-in overcurrent and undervoltage devices to protect down stream conductors and equipment from overcurrent loads. These breakers can be operated automatically by built-in devices or by manually built-in toggle switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

* **Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Circuit breaker broken or damaged. ***{Severity H}	EA	3	
g. Security devices missing or inoperable. ***{Severity H}	EA		

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.02 CIRCUIT BREAKERS (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Hot Spots:			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	4	2
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	4	2

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.03 DISCONNECT SWITCHES (LOW VOLTAGE)

Disconnect switches (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. Two types of disconnect switches are fused or non-fused. Disconnect switches are normally manually operated but could be electrically operated.

Disconnect switch with a fuse unit. The safety disconnect switch provides both overload and short circuit protection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Door handle bent or inoperative. ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Security devices missing or inoperative. ***{Severity H}	EA		
g. Carbon tracking due to flashovers. ***{Severity H}	EA	5	
h. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	5	

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.03 DISCONNECT SWITCHES (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal, blade end or fuse clip 5° to 24°C above ambient. ***{Severity M}	EA	6	3
b. Terminal, blade end or fuse clip 25°C or more above ambient. ***{Severity H}	EA	6	3

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.04 MOTOR STARTERS/CONTACTORS

Motor starters are devices housed in an enclosure and used for controlling electrical motors. These devices consist of the following: disconnect switches, circuit breakers, contactors, control transformers, fuses, various types of relays, pushbuttons, selector switches, pilot lights, metering devices, etc. Required components depend on the complexity of the motor control function. Control functions provided by motor starters are; starting, accelerating, reversing rotation, cycling, jogging and stopping electrical motors. The complexity of control functions depends on the operational requirements the motors are to fulfill.

Magnetic and auxiliary contactors are used to switch lighting and heating loads, capacitors, transformers and electric motors where overload protection is separately provided. Contactors can be used as accessories to various pieces of equipment such as disconnect switches, circuit breakers, light controls or operate alone with its own accessories.

Circuit breakers and disconnect switches located in motor starters will be inspected under a separate component. The motor starter housing and devices therein will be inspected by this standard.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Pilot light damaged or inoperative. ***{Severity L}	EA		
c. Metering device loose or damaged. ***{Severity L}	EA		
d. Panel fastener loose, broken or missing. ***{Severity L}	EA		

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.04 MOTOR STARTERS/CONTACTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage: (Continued)**			
e. Interior not clean or moisture-free. ***{Severity L}	EA	7	
f. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
g. Control device loose or damaged. ***{Severity M}	EA		
h. Unused opening not covered. ***{Severity M}	EA		
i. Door handle bent or inoperative. ***{Severity H}	EA		
j. Security devices missing or inoperative. ***{Severity H}	EA		
k. Unit not grounded. ***{Severity H}	EA	7	
l. Switch or pushbutton damaged or broken. ***{Severity M}	EA		

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	8	4
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	8	4

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.05 TRANSFORMERS

Transformers are static electric devices consisting of a single winding or multiple coupled windings with or without a magnetic core. Power is transferred by electromagnetic induction from the input to the output circuit usually with changed values of voltages and currents.

Transformers have six types of functions: power transformers converts one voltage source to another voltage power source, isolation transformers shields the load side winding from the line side winding, reduced voltage starting transformers reduces the motor terminal voltage during the starting cycle, buck/boost transformers either raise or lower output voltage to accommodate the load, current transformers proportions a high current flow to a low current flow for instrumentation and control purpose and potential transformers proportions a high voltage potential to a low voltage potential for instrumentation and control purposes.

Transformers, other than current and potential transformers, smaller than 5 kVA single phase or 15 kVA multi phase, will not be inspected. All current and potential transformers will be inspected.

Surge (lightning) arresters, insulators, foundations, poles and conductors bare will be inspected under separate components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		9
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		9

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Air intake/exhaust ducts blocked. ***{Severity M}	EA		

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.05 TRANSFORMERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (continued):**			
e. Air filters dirty or missing. ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Loose or broken mounting brackets. ***{Severity M}	EA		
h. Cooling fan guard/blade broken or missing. ***{Severity H}	EA		
i. Unit not grounded. ***{Severity H}	EA		
j. Gauge or meter broken or missing. ***{Severity M}	EA		
k. Security lock missing or inoperable. ***{Severity H}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Oil Leak:**			
Observation:			
a. Oil on surface of tank (possible oil leak). ***{Severity L}	EA		10
b. Oil puddle under or around base of tank. ***{Severity H}	EA		10

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	9	5
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	9	5
c. Oil cooling fin blocked. ***{Severity H}	EA		11
d. Low oil level (less than 2" above fin). ***{Severity H}	EA		11

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.06 TRANSFER SWITCHES

Transfer switch has two power inputs, each from a separate power source and a single output to feed a given load. The purpose of the switch is to provide a means of transferring the load from one power source to another without remaking manual connections.

Transfer switches can be manually operated or both manually and automatically operated.

Transfer switches may be mounted independently or in substations, switchboards or motor control centers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Pilot light damaged or inoperative. ***{Severity L}	EA		
d. Interior not clean or moisture free. ***{Severity L}	EA	10	
e. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Handle bent or inoperative. ***{Severity H}	EA		

10.08 MOTOR CONTROL CENTERS (MCC)

COMPONENTS (Continued)

◆ 10.08.06 TRANSFER SWITCHES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Damage (continued):**			
h. Security devices missing or inoperative. ***{Severity H}	EA		
i. Carbon tracking due to flashovers. ***{Severity H}	EA	10	
j. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	10	
k. Unit not grounded. ***{Severity H}	EA	10	
l. Switch or pushbutton damaged or broken. ***{Severity M}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	11	6
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	11	6

10.08 MOTOR CONTROL CENTERS (MCC)

REFERENCES

1. DOE CAS Manual, Volume 9: 0.09, Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.08 MOTOR CONTROL CENTERS (MCC)

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.08.01-1
2	GS-II 10.08.01-2
3	GS-II 10.08.02-3
4	GS-II 10.08.02-4
5	GS-II 10.08.03-5
6	GS-II 10.08.03-6
7	GS-II 10.08.04-7
8	GS-II 10.08.04-8
9	GS-II 10.08.05-9
10	GS-II 10.08.06-10
11	GS-II 10.08.06-11
12	GS-II 10.08.01-12

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.08.01-1
2	GS-III 10.08.02-2
3	GS-III 10.08.03-3
4	GS-III 10.08.04-4
5	GS-III 10.08.05-5
6	GS-III 10.08.06-6
7*	GS-III 10.08-7
8	GS-III 10.08.01-8
9	GS-III 10.08.05-9
10	GS-III 10.08.05-10
11	GS-III 10.08.05-11

* Indicates guide sheets which are not directly referenced by a Key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.08.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.08.01-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.08.01-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.08.02-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.08.02-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.08.02-4

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.08.03-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.08.03-6

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.08.03-6

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.08.04-7

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.08.04-8

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.08.04-8

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-II 10.08.05-9

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-II 10.08.05-9

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 10

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.08.06-10

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.08.06-11

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11 (Continued)

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.08.06-11

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 12

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.08.01-12

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.

3. A Level II Help Screen Chart will convert readings to percentages by observation.

4. Close panels or doors carefully after the inspection is completed.

5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 12

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.08.01-12

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\%\ \text{Overload} = \frac{(\text{Measured Current} - \text{Full Load Current})\ \text{Times}\ 100}{\text{Full Load Current}}$$

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.08.01-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.08.01-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.08.02-2

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.08.02-2

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.08.03-3

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.08.03-3

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-III 10.08.04-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-III 10.08.04-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-III 10.08.05-5

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-III 10.08.05-5

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: TRANSFER SWITCH
CONTROL NUMBER: GS-III 10.08.06-6

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: TRANSFER SWITCH
CONTROL NUMBER: GS-III 10.08.06-6

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: MOTOR CONTROL CENTERS (MCC)/PANELBOARDS (400 AMPS & ABOVE)

CONTROL NUMBER: GS-III 10.08-7*

Application

This guide applies to the inspection of Motor Control Centers (MCC)/Panelboards as a complete subsystem. This inspection, while a part of the Condition Assessment Survey, is triggered by information beyond the inspection process such as time, age, or repeated service calls.

Special Safety Requirements

Inspectors need to have complete control of the Motor Control Centers (MCC)/Panelboards while performing the inspection. During a portion of the inspection the Motor Control Centers (MCC)/Panelboards will be taken out of service. Therefore the inspection of the Motor Control Centers (MCC)/Panelboards will be scheduled accordingly to accommodate the inspection requirements. No other safety requirements are required for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate Motor Control Centers (MCC)/Panelboards maintenance log or records and review the following material:
   a. Number of trips per protective device in the last 12 months of operation.
   b. Number of motor overload relays - thermal type (Heater Elements) replacements.
   c. Flash over problems.
   d. Scheduled checks for tightness of bus bars and terminal connections.
   e. Adequacy of maintenance logs or records.

2. Specify corrective action for problem areas:
   a. If a feeder circuit breaker trips or disconnect switch fuse blows more than twice a year, determine the existing electrical load and verify the size of the existing circuit breakers or disconnect switches and their fuse rating together with the feeder conductor size. These units and any associated feeders having incorrect ratings should be changed out.
   b. If the overload thermal element trips or burnout of the element occurs more than twice a year on any given starter, verify the motor full-load current and locked motor data found on the motor rating nameplate. Refer to the manufacturer's heater selection and application charts for correct heater size.
   c. If flash overs occur, investigate the problem and indicate the cause.
   d. If bus bar connections have not been tightened in the last 5 years, specify these connections be checked for proper tightness per manufacturers recommendation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: MOTOR CONTROL CENTERS (MCC)/PANELBOARDS (400 AMPS & ABOVE)

CONTROL NUMBER: GS-III 10.08-7*

Inspection Actions (Continued)

e. If some or all of the above information is not available from the maintenance logs or records, request that required records be kept.

3. Provide an inspection of the Motor Control Center (MCC) or Panelboard and their components as specified by the equipment manufacturer. If there is no such recommendation, then provide an inspection as outlined in NFPA 70B *"Recommended Practices for Electrical Equipment Maintenance"*, latest edition.

Special Tools and Equipment

The following is a list of special tools and equipment required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required
2. Infrared Scanner, Raytek Inc., #PM2EM-L2
3. Torque wrench

Recommended Inspection Frequency

Follow manufacturer's recommendations for frequency of inspection of the Motor Control Center (MCC)/Panelboard assembly for the first 3 years. If there is no manufacturer's recommendation than an annual inspection should be performed during this 3 year period. After the first 3 years of service, inspection frequency can be increased or decreased dictated by the past observations or experiences. When the number of service calls since the last inspection equals 4, the up-coming inspection should be performed immediately.

References

1. NFPA 70B, *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-III 10.08.01-8

Application

This guide applies to the investigation of enclosure with bus bars that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the enclosure with bus bars.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter

2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.08.05-9

Application

This guide applies to the investigation of 112.5 kVA transformers or larger that contain liquids used as electrical insulation and coolant.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning the corrosive condition of the tank containing the coolant and insulation liquid.
2. If the tank has corroded to the point where contaminated air could possibly pass through the tank wall an oil analysis should be performed.
3. If the liquid is contaminated, provide test to determine how the tank leaks.
4. Analyze the test results to determine whether the transformer can be repaired or must be replaced.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Wire brush
2. Wrenches
3. Pressure gauge
4. Inert gas supply

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.08.05-10

Application

This guide applies to the investigation of oil leaks in the transformer tank that has signs of oil on surface of the tank or an oil puddle under or around base of tank.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by finding the source of the oil. If the oil is coming from an external source no further inspection of the transformer is required. The external source should be identified and recommendations made to eliminate the contamination of the breaker.
2. If the oil source is coming from within the transformer, a determination should be made as how the oil is escaping.
3. If transformer repairs are made, oil analysis should be made after the repairs to determine if the oil is contaminated.
4. All contaminated oil should be removed and replaced with new oil.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Brush
2. Non-flammable cleaning fluid
3. Wiping material

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.08.05-11

Application

This guide applies to the investigation of 112.5 kVA transformers or larger that contain liquids used as electrical insulation and coolant.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning cooling fin blockage or low liquid level.
2. Do a liquid analysis test.
3. If liquid analysis test results are okay, add liquid to proper level requirements.
4. If fin blockage remains, have liquid removed and clear the fin blockage.
5. If liquid analysis test results show contaminates, have the liquid removed, the contaminates flushed out and new liquid added.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared scanner
2. Tools and sampling containers for taking liquid samples and transferring these samples to the lab.
3. Tools and liquid supplies for adding the appropriate liquid to the transformer tank.

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

10.09 SWITCHBOARDS

DESCRIPTION

Switchboards are subsystems of the Building Electrical System. A switchboard is a large single panel, frame or an assembly of panels, on which are mounted, on the face or back or both, disconnect switches, breakers and other overcurrent and protective devices. Switchboards also include bus bars, metering and transfer switches.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tool, beyond the requirements listed in the Standard Tool Section shall be provided to perform the inspection of the Switchboard.

1. Infrared scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of the Switchboard, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.09.01 ENCLOSURES WITH BUS BARS
- ◆ 10.09.02 METERING
- ◆ 10.09.03 TRANSFER SWITCHES
- ◆ 10.09.04 CIRCUIT BREAKERS (LOW VOLTAGE)
- ◆ 10.09.05 DISCONNECT SWITCHES (LOW VOLTAGE)

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.09 SWITCHBOARDS

COMPONENTS

◆ 10.09.01 ENCLOSURES WITH BUS BARS

Enclosures with bus bars, their connections and structural steel that make up the enclosure, for motor control centers, panelboards, switchboards, switchyard and substations, includes doors and panels that are not part of any equipment mounted in the enclosure. Doors and panels not included in the enclosure inspection are those for circuit breakers, disconnect switches, combination starters, etc. which would be inspected as part of those components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Panel fastener loose, broken or missing. ***{Severity L}	EA		
b. Excessive dust, dirt or moisture accumulation. ***{Severity L}	EA	1	
c. Enclosure mounting loose, broken or missing. ***{Severity M}	EA		
d. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Vent opening blocked. ***{Severity M}	EA		
g. Air filters dirty or missing. ***{Severity M}	EA	1	
h. Unit not grounded. ***{Severity H}	EA	1	

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.01 ENCLOSURES WITH BUS BARS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Bus connection 5° to 24°C above ambient. ***{Severity M}	EA	2	1
b. Bus connection 25°C or more above ambient. ***{Severity H}	EA	2	1

Defect:

* **Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	10	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	10	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	10	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	10	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	10	8
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	10	8
g. Load current more than 2% above FLC. ***{Severity H}	EA	10	8

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.02 METERING

Metering consists of devices used to measure voltage, current and Kilowatt Hour (KWH) usage at given locations. KWH metering may include measuring peak demand loads over a billing period on a continuous basis or a 24 hour on-peak / off-peak load basis. The KWH and peak demand loads are usually measured by a single meter unit.

Depending on voltage levels, voltage signal for metering purposes can be taken directly across lines or from potential transformers connected across lines being monitored.

Depending on voltage levels and maximum current flow, ampere signals for metering purposes can be taken from current flow through the meters or signals from either shunts or current transformers connected to the lines being metered.

Current and voltage readings at metering points can be taken with individual meters or selector switches can be used in conjunction with meters such that a single ampere or volt meter along with its individual selector switch can read the current or voltage at multi metering points.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.02 METERING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage: (Continued)**			
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Glass broken or missing. ***{Severity M}	EA		
e. Selector switch broken or missing. ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Meter broken. ***{Severity H}	EA		2

Defect:

*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	3	3
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	3	3

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.03 TRANSFER SWITCHES

Transfer switch has two power inputs, each from a separate power source and a single output to feed a given load. The purpose of the switch is to provide a means of transferring the load from one power source to another without remaking manual connections.

Transfer switches can be manually operated or both manually and automatically operated.

Transfer switches may be mounted independently or in substations, switchboards or motor control centers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Pilot light damaged or inoperative. ***{Severity L}	EA		
d. Interior not clean or moisture free. ***{Severity L}	EA	4	
e. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.03 TRANSFER SWITCHES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage (continued):**			
f. Unused opening not covered. ***{Severity M}	EA		
g. Handle bent or inoperative. ***{Severity H}	EA		
h. Security devices missing or inoperative. ***{Severity H}	EA		
i. Carbon tracking due to flashovers. ***{Severity H}	EA	4	
j. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	4	
k. Unit not grounded. ***{Severity H}	EA	4	
l. Switch or pushbutton damaged or broken. ***{Severity M}	EA		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	5	4
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	5	4

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.04 CIRCUIT BREAKERS (LOW VOLTAGE)

Circuit breakers (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. They contain built-in overcurrent and undervoltage devices to protect down stream conductors and equipment from overcurrent loads. These breakers can be operated automatically by built-in devices or by manually built-in toggle switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Circuit breaker broken or damaged. ***{Severity H}	EA	6	
g. Security devices missing or inoperative. ***{Severity H}	EA		

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.04 CIRCUIT BREAKERS (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	7	5
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	7	5

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.05 DISCONNECT SWITCHES (LOW VOLTAGE)

Disconnect switches (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. Two types of disconnect switches are fused or non-fused. Disconnect switches are normally manually operated but could be electrically operated.

Disconnect switch with a fuse unit provides both overload and short circuit protection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Door handle bent or inoperative. ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Security devices missing or inoperative. ***{Severity H}	EA		
g. Carbon tracking due to flashovers. ***{Severity H}	EA	8	
h. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	8	

10.09 SWITCHBOARDS

COMPONENTS (Continued)

◆ 10.09.05 DISCONNECT SWITCHES (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal, blade end or fuse clip 5° to 24°C above ambient. ***{Severity M}	EA	9	6
b. Terminal, blade end or fuse clip 25°C or more above ambient. ***{Severity H}	EA	9	6

10.09 SWITCHBOARDS

REFERENCES

1. DOE CAS Manual, Volume 9: 0.09, Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.09 SWITCHBOARDS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.09.01-1
2	GS-II 10.09.01-2
3	GS-II 10.09.02-3
4	GS-II 10.09.03-4
5	GS-II 10.09.03-5
6	GS-II 10.09.04-6
7	GS-II 10.09.04-7
8	GS-II 10.09.05-8
9	GS-II 10.09.05-9
10	GS-II 10.09.01-10

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.09.01-1
2	GS-III 10.09.02-2
3	GS-III 10.09.02-3
4	GS-III 10.09.03-4
5	GS-III 10.09.04-5
6	GS-III 10.09.05-6
7*	GS-III 10.09-7
8	GS-III 10.09.01-8

* Indicates guide sheets which are not directly referenced by a Key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.09.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.09.01-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.09.01-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: METERING
CONTROL NUMBER: GS-II 10.09.02-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.
2. Make temperature measurements with an infrared scanner.
3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.
4. Measure the temperature of the device specified.
5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.
6. Record the results.
7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-II 10.09.02-3

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-II 10.09.03-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.04-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.04-5

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.04-6

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.04-7

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.04-7

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.05-8

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.05-9

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.09.05-9

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 10

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.09.01-10

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.

3. A Level II Help Screen Chart will convert readings to percentages by observation.

4. Close panels or doors carefully after the inspection is completed.

5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 10

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.09.01-10

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\% \text{ Overload} = \frac{(\text{Measured Current} - \text{Full Load Current}) \text{ Times } 100}{\text{Full Load Current}}$$

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.09.01-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.09.01-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.09.02-2

Application

This guide applies to the investigation of a broken meter that has received physical damage or is not operating.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. For physically damaged units, inspect to verify if the unit is damaged to the point where it is no longer sealed from dust, water or insects entering the housing. If the seal is broken the housing should be replaced and the existing meter should be repaired or discarded.

2. If the meter is not operating, follow the following procedure:

   a. Check all fuses and replace those fuses that are blown.
   b. Check current transformers (CT) for output when power is being used. CT may be burnt out or overloaded. CT secondary circuit must not be opened or overloaded when current flows through the primary. Under the above operating conditions the CT could be destroyed.
   c. Check potential transformers (PT) for output when power is on. PT may not provide the proper voltage output.
   d. Check selector switches for proper operation and low contact resistance. If switch is malfunctioning it should be replaced.
   e. Check circuitry for proper connections. Any improper connection could cause damage to the meter, CT or PT. Damaged devices need to be repaired or replaced.
   f. Check all electrical terminals for loose connections and tighten those required.
   g. Check for broken and insulation-damaged conductors. Replace conductors as required.
   h. After the above items have been checked out, the necessary repairs and replacements have been made and the meter is still malfunctioning, the meter should be replaced and the original meter sent to the shop for repair or scrapping.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.09.02-2

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.09.02.3

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.09.02-3

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-III 10.09.03-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: TRANSFER SWITCHES
CONTROL NUMBER: GS-III 10.09.03-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.09.04-5

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.09.04-5

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.09.05-6

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.09.05-6

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: SWITCHYARDS/SWITCHBOARDS
CONTROL NUMBER: GS-III 10.09-7*

Application

This guide applies to the inspection of switchyards and switchboards as a complete subsystem. This inspection, while a part of the Condition Assessment Survey, is triggered by information beyond the inspection process such as time, age, or repeated service calls.

Special Safety Requirements

Inspectors need to have complete control of the switchyard or switchboard while performing the inspection. During a portion of the inspection the switchyard or switchboard will be taken out of service. Therefore the inspection of the switchyard or switchboard will be scheduled accordingly to accommodate the inspection requirements. No other safety requirements are required for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate switchyard or switchboard's maintenance log or records and review the following material:
   a. Date of the latest Short Circuit Analysis.
   b. Number of trips per protective device in the last 12 months of operation.
   c. Coordination study of protective device.
   d. Flash over problems.
   e. Scheduled checks for tightness of bus bars and terminal connections.
   f. Adequacy of maintenance logs or records.

2. Specify corrective action for problem areas:
   a. If there has not been a "Short Circuit Analysis" in the last 10 years or since the last incoming power source upgrade, a new study shall be made to determine the availability of short circuit current at various equipment locations.
   b. If a feeder circuit breaker trips or disconnect switch fuse blows more than twice a year, specify an Electrical Energy Analysis be made to verify the size of the existing circuit breakers or disconnect switches and their fuse rating. These units and any associated feeders having incorrect ratings should be changed out.
   c. If a back-up protective device trips or blows consistently before the equipment protective device trips or blows, specify a Protective Device Coordination Study be made for coordinating the characteristics of the protective device.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: SWITCHYARDS/SWITCHBOARDS
CONTROL NUMBER: GS-III 10.09-7*

Inspection Actions (Continued)

d. If flash overs occur, investigate the problem and indicate the cause.
e. If bus bar connections have not been tightened in the last 5 years, specify these connections be checked for proper tightness per manufacturers recommendation.
f. If some or all of the above information is not available from the maintenance logs or records, request that required records be kept.

3. Provide an inspection of the switchyard or switchboard and their components as specified by the equipment manufacturer. If there is no such recommendation, then provide an inspection as outlined in NFPA 70B *"Recommended Practices for Electrical Equipment Maintenance"*, latest edition.

Special Tools and Equipment

The following is a list of special tools and equipment required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek Inc., #PM2EM-L2
2. Torque wrench
3. Refer to manufacturer maintenance guide for additional special tools required

Recommended Inspection Frequency

Follow manufacturer's recommendations for frequency of inspection of the switchyard/switchboard assembly for the first 3 years. If there is no manufacturer's recommendation than an annual inspection should be performed during this 3 year period. After the first 3 years of service, inspection frequency can be increased or decreased dictated by the past observations or experiences. When the number of service calls since the last inspection equals 4, the up-coming inspection should be performed immediately.

References

1. NFPA 70B, *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-III 10.09.01-8

Application

This guide applies to the investigation of enclosures with bus bars that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the enclosure with bus bars.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter

2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

10.10 PANELBOARDS

DESCRIPTION

Panelboards are subsystems of the Building Electrical System. Panelboards are electrical units designed for assembly in the form of a single panel and are used for control of lighting, heating and power circuit requirements. Devices making-up a panelboard consists mainly of bus bars, branch circuit breakers or fusible switches and motor starters/contactors.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tool, beyond the requirements listed in the Standard Tool Section shall be provided as required to perform the inspection of the Switchboard.

1. Infrared scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of the Panelboard, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 10.10.01 ENCLOSURES WITH BUS BARS
- ◆ 10.10.02 CIRCUIT BREAKERS (LOW VOLTAGE)
- ◆ 10.10.03 DISCONNECT SWITCHES (LOW VOLTAGE)
- ◆ 10.10.04 MOTOR STARTERS/CONTACTORS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.10 PANELBOARDS

COMPONENTS

◆ 10.10.01 ENCLOSURES WITH BUS BARS

Enclosures with bus bars, their connections and structural steel that make up the enclosure, for motor control centers, panelboards, switchboards, switchyard and substations, includes doors and panels that are not part of any equipment mounted in the enclosure. Doors and panels not included in the enclosure inspection are those for circuit breakers, disconnect switches, combination starters, etc. which would be inspected as part of those components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Panel fastener loose, broken or missing. ***{Severity L}	EA		
b. Excessive dust, dirt or moisture accumulation. ***{Severity L}	EA	1	
c. Enclosure mounting loose, broken or missing. ***{Severity M}	EA		
d. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
e. Unused openings not covered. ***{Severity M}	EA		
f. Vent openings blocked. ***{Severity M}	EA		
g. Air filters dirty or missing. ***{Severity M}	EA	1	
h. Unit not grounded. ***{Severity H}	EA	1	

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.01 ENCLOSURES WITH BUS BARS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Bus connection 5° to 24°C above ambient. ***{Severity M}	EA	2	1
b. Bus connection 25°C or more above ambient. ***{Severity H}	EA	2	1

Defect:

* **Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	9	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	9	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	9	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	9	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	9	6
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	9	6
g. Load current more than 2% above FLC. ***{Severity H}	EA	9	6

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.02 CIRCUIT BREAKERS (LOW VOLTAGE)

Circuit breakers (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. They contain built-in overcurrent and undervoltage devices to protect down stream conductors and equipment from overcurrent loads. These breakers can be operated automatically by built-in devices or by manually built-in toggle switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Circuit breaker broken or damaged. ***{Severity H}	EA	3	
g. Security devices missing or inoperative. ***{Severity H}	EA		

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.02 CIRCUIT BREAKERS (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	4	2
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	4	2

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.03 DISCONNECT SWITCHES (LOW VOLTAGE)

Disconnect switches (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. Two types of disconnect switches are fused or non-fused. Disconnect switches are normally manually operated but could be electrically operated.

Disconnect switch with a fuse unit provides both overload and short circuit protection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Door handle bent or inoperative. ***{Severity M}	EA		
e. Unused opening not covered. ***{Severity M}	EA		
f. Security devices missing or inoperative. ***{Severity H}	EA		
g. Carbon tracking due to flashovers. ***{Severity H}	EA	5	
h. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	5	

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.03 DISCONNECT SWITCHES (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal, blade end or fuse clip 5° to 24°C above ambient. ***{Severity M}	EA	6	3
b. Terminal, blade end or fuse clip 25°C or more above ambient. ***{Severity H}	EA	6	3

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.04 MOTOR STARTERS/CONTACTORS

Motor starters are devices housed in an enclosure and used for controlling electrical motors. These devices consist of the following: disconnect switches, circuit breakers, contactors, control transformers, fuses, various types of relays, pushbuttons, selector switches, pilot lights, metering devices, etc. Required components depend on the complexity of the motor control function. Control functions provided by motor starters are; starting, accelerating, reversing rotation, cycling, jogging and stopping electrical motors. The complexity of control functions depends on the operational requirements the motors are to fulfill.

Magnetic and auxiliary contactors are used to switch lighting and heating loads, capacitors, transformers and electric motors where overload protection is separately provided. Contactors can be used as accessories to various pieces of equipment such as disconnect switches, circuit breakers, light controls or operate alone with its own accessories.

Circuit breakers and disconnect switches located in motor starters will be inspected under a separate component. The motor starter housing and devices therein will be inspected by this standard.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or damaged. ***{Severity L}	EA		
b. Pilot light damaged or inoperative. ***{Severity L}	EA		
c. Metering device loose or damaged. ***{Severity L}	EA		

10.10 PANELBOARDS

COMPONENTS (Continued)

◆ 10.10.04 MOTOR STARTERS/CONTACTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage: (Continued)**			
d. Panel fastener loose, broken or missing. ***{Severity L}	EA		
e. Interior not clean or moisture-free. ***{Severity L}	EA	7	
f. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
g. Control device loose or damaged. ***{Severity M}	EA		
h. Unused opening not covered. ***{Severity M}	EA		
i. Door handle bent or inoperative. ***{Severity H}	EA		
j. Security devices missing or inoperative. ***{Severity H}	EA		
k. Unit not grounded. ***{Severity H}	EA	7	
l. Switch or pushbutton damaged or missing. ***{Severity M}	EA		

Defect:

*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	8	4
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	8	4

10.10 PANELBOARDS

REFERENCES

1. DOE CAS Manual, Volume 9: 0.09, Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.10 PANELBOARDS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 10.10.01-1
2	GS-II 10.10.01-2
3	GS-II 10.10.02-3
4	GS-II 10.10.02-4
5	GS-II 10.10.03-5
6	GS-II 10.10.03-6
7	GS-II 10.10.04-7
8	GS-II 10.10.04-8
9	GS-II 10.10.01-9

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 10.10.01-1
2	GS-III 10.10.02-2
3	GS-III 10.10.03-3
4	GS-III 10.10.04-4
5*	GS-III 10.10-5*
6	GS-III 10.10.01-6

* Indicates guide sheets which are not directly referenced by a Key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.10.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.10.01-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.10.01-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.10.02-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.10.02-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.10.02.4

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.10.03-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.10.03-6

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.10.03-6

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.10.04-7

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.10.04-8

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-II 10.10.04-8

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.10.01-9

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.

2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.

3. A Level II Help Screen Chart will convert readings to percentages by observation.

4. Close panels or doors carefully after the inspection is completed.

5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 9

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.10.01-9

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\% \text{ Overload} = \frac{(\text{Measured Current - Full Load Current}) \text{ Times } 100}{\text{Full Load Current}}$$

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.10.01-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.10.01-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.10.02-2

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.10.02-2

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.10.03-3

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.10.03-3

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-III 10.10.04-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: MOTOR STARTERS/CONTACTORS
CONTROL NUMBER: GS-III 10.10.04-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5*

COMPONENT: MOTOR CONTROL CENTERS (MCC)/PANELBOARDS (400 AMPS & ABOVE)

CONTROL NUMBER: GS-III 10.10-5*

Application

This guide applies to the inspection of Motor Control Centers (MCC)/Panelboards as a complete subsystem. This inspection, while a part of the Condition Assessment Survey, is triggered by information beyond the inspection process such as time, age, or repeated service calls.

Special Safety Requirements

Inspectors need to have complete control of the Motor Control Centers (MCC)/Panelboards while performing the inspection. During a portion of the inspection the Motor Control Centers (MCC)/Panelboards will be taken out of service. Therefore the inspection of the Motor Control Centers (MCC)/Panelboards will be scheduled accordingly to accommodate the inspection requirements. No other safety requirements are required for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate Motor Control Centers (MCC)/Panelboards maintenance log or records and review the following material:
   a. Number of trips per protective device in the last 12 months of operation.
   b. Number of motor overload relays - thermal type (Heater Elements) replacements.
   c. Flash over problems.
   d. Scheduled checks for tightness of bus bars and terminal connections.
   e. Adequacy of maintenance logs or records.

2. Specify corrective action for problem areas:
   a. If a feeder circuit breaker trips or disconnect switch fuse blows more than twice a year, determine the existing electrical load and verify the size of the existing circuit breakers or disconnect switches and their fuse rating together with the feeder conductor size. These units and any associated feeders having incorrect ratings should be changed out.
   b. If the overload thermal element trips or burnout of the element occurs more than twice a year on any given starter, verify the motor full-load current and locked motor data found on the motor rating nameplate. Refer to the manufacturer's heater selection and application charts for correct heater size.
   c. If flash overs occur, investigate the problem and indicate the cause.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5* (Continued)

COMPONENT: MOTOR CONTROL CENTERS (MCC)/PANELBOARDS (400 AMPS & ABOVE)

CONTROL NUMBER: GS-III 10.10-5*

Inspection Actions (Continued)

d. If bus bar connections have not been tightened in the last 5 years, specify these connections be checked for proper tightness per manufacturers recommendation.

e. If some or all of the above information is not available from the maintenance logs or records, request that required records be kept.

3. Provide an inspection of the Motor Control Center (MCC) or Panelboard and their components as specified by the equipment manufacturer. If there is no such recommendation, then provide an inspection as outlined in NFPA 70B *"Recommended Practices for Electrical Equipment Maintenance"*, latest edition.

Special Tools and Equipment

The following is a list of special tools and equipment required beyond those listed in the Standard Tool Section.

1. Refer to manufacturer maintenance guide for special tools required
2. Infrared Scanner, Raytek Inc., #PM2EM-L2
3. Torque wrench

Recommended Inspection Frequency

Follow manufacturer's recommendations for frequency of inspection of the Motor Control Center (MCC)/Panelboard assembly for the first 3 years. If there is no manufacturer's recommendation than an annual inspection should be performed during this 3 year period. After the first 3 years of service, inspection frequency can be increased or decreased dictated by the past observations or experiences. When the number of service calls since the last inspection equals 4, the up-coming inspection should be performed immediately.

References

1. NFPA 70B, *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-III 10.10.01-6

Application

This guide applies to the investigation of enclosure with bus bars that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the enclosure with bus bars.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter

2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

10.11 SUBSTATIONS

DESCRIPTION

Substations are a subsystem of the Building Electrical System. Substations receive power from high voltage power sources, transforms the incoming power to a lower voltage level and distributes the power to terminal points for distribution to remote distribution centers and/or end load devices. There are two types of substations, the single-ended and the double-ended units.

Single-ended substations receive power from a single power source. Power input to the substations is to a transformer located on one end of the substation. Power feed may connect directly to the primary (high voltage) side of the transformer or to a primary power switch that feeds the primary side of the transformer.

Double-ended substations receive power from two power sources. Power inputs to the substation are to two transformers, one located on each end of the substation. Power feed may connect directly to the primary (high voltage) side of the transformers or primary power switch that feed the primary side of the transformers.

Secondary bus in a single-ended substation is a continuous bus and the feeder power switches are fed from this bus. Secondary bs in a double-ended substation is divided in two sections and tied together by a tie power switch. Some of the feeder power switches are fed from one section of the bus and the remaining feeder power switches are fed from the other section.

In a single-ended substation the secondary bus feeding the terminal points is fed from one source, a single transformer. In a double-ended substation, if the tie power switch is closed, the secondary bus can be fed from either transformer or if the tie power switch is open each side of the secondary bus can be fed by the adjacent transformer.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tool, beyond the requirements listed in the Standard Tool Section shall be provided to perform the inspection of the Substation:

1. Infrared scanner, Raytek, Inc., #PM2EM-L2

SPECIAL SAFETY REQUIREMENTS

Interior compartments containing devices rated above 600V shall not be inspected by Level I/Level II inspectors. No other special safety requirements are needed for the inspection of the Substation subsystem beyond the requirements listed in the Master Safety Plan and System Safety Section.

10.11 SUBSTATIONS

COMPONENT LIST

- 10.11.01 ENCLOSURES WITH BUS BARS
- 10.11.02 METERING
- 10.11.03 SURGE (LIGHTNING) ARRESTERS
- 10.11.04 CIRCUIT BREAKERS (MEDIUM VOLTAGE)
- 10.11.05 CIRCUIT BREAKERS (LOW VOLTAGE)
- 10.11.06 DISCONNECT SWITCHES (MEDIUM VOLTAGE)
- 10.11.07 DISCONNECT SWITCHES (LOW VOLTAGE)
- 10.11.08 TRANSFORMERS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

10.04 POWER CONTROL
10.05 GROUNDING SYSTEM
10.06 RACEWAYS

STANDARD INSPECTION PROCEDURE

Components require a Level I or Level II inspection as part of the basic inspection process. Other additional Level II inspection may be indicated or "triggered" by a Level I inspection and should be accomplished by the inspector at that time. Level III inspection may be indicated or "triggered" by a Level I or II inspection Defect/Observation and should be accomplished at the direction of the Facility Manager.

Inspection should be carried out in the order of presentation for the various components with associated defects and observations for each subsystem listed in the inspector's CAIS.

10.11 SUBSTATIONS

COMPONENTS

◆ 10.11.01 ENCLOSURES WITH BUS BARS

Enclosures with bus bars, their connections and structural steel that make up the enclosure, for motor control centers, panelboards, switchboards, switchyard and substations, includes doors and panels that are not part of any equipment mounted in the enclosure. Doors and panels not included in the enclosure inspection are those for circuit breakers, disconnect switches, combination starters, etc. which would be inspected as part of those components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident).	SF		
***{Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
***{Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
***{Severity H}			

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Damage:**			
Observation:			
a. Panel fastener loose, broken or missing.	EA		
***{Severity L}			
b. Excessive dust, dirt or moisture accumulation.	EA	1	
***{Severity L}			
c. Enclosure mounting loose, broken or missing.	EA		
***{Severity M}			
d. Enclosure damaged (cannot be sealed).	EA		
***{Severity M}			
e. Unused opening not covered.	EA		
***{Severity M}			
g. Air filters dirty or missing.	EA	1	
***{Severity M}			
f. Vent opening blocked.	EA		
***{Severity M}			
h. Unit not grounded.	EA	1	
***{Severity H}			

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.01 ENCLOSURES WITH BUS BARS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Hot Spots:**			
Observation:			
a. Bus connection 5° to 24°C above ambient. ***{Severity M}	EA	2	1
b. Bus connection 25°C or more above ambient. ***{Severity H}	EA	2	1

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Electrical Power:**			
Observation:			
a. Voltage unbalance plus/minus 2 to 2.9%. ***{Severity L}	EA	9	
b. Voltage from normal plus 4 to 5.9%/minus 3 to 4.9%. ***{Severity L}	EA	9	
c. Voltage unbalanced plus/minus 3 to 4.9%. ***{Severity M}	EA	9	
d. Voltage from normal plus 6 to 9.9%/ minus 5 to 7.9%. ***{Severity M}	EA	9	
e. Voltage unbalance plus/minus 5% or more. ***{Severity H}	EA	9	8
f. Voltage from normal plus 10% or more/ minus 8% or more. ***{Severity H}	EA	9	8
g. Load current more than 2% above FLC. ***{Severity H}	EA	9	8

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.02 METERING

Metering consists of devices used to measure voltage, current and Kilowatt Hour (KWH) usage at given locations. KWH metering may include measuring peak demand loads over a billing period on a continuous basis or a 24 hour on-peak / off-peak load basis. The KWH and peak demand loads are usually measured by a single meter unit.

Depending on voltage levels, voltage signal for metering purposes can be taken directly across lines or from potential transformers connected across lines being monitored.

Depending on voltage levels and maximum current flow, ampere signals for metering purposes can be taken from current flow through the meters or signals from either shunts or current transformers connected to the lines being metered.

Current and voltage readings at metering points can be taken with individual meters or selector switches can be used in conjunction with meters such that a single ampere or volt meter along with its individual selector switch can read the current or voltage at multi metering points.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.02 METERING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage: (Continued)**			
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Glass broken or missing. ***{Severity M}	EA		
e. Selector switch broken or missing. ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Meter broken. ***{Severity H}	EA		2

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	3	3
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	3	3

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.03 SURGE (LIGHTNING) ARRESTERS

Surge Arrester is a protective device for limiting surge voltages by discharging or bypassing surge current to ground. As soon as the surge voltage subsides to a low value the current to ground is quenched. The surge arrester is capable of repeating this function many times automatically without any outside input.

There are four basic arresters defined by industry standards; secondary, distribution, intermediate, and station type. These arresters utilize expulsion, silicone carbide valve element, or metal oxide valve element technology to consistently limit voltage surges to a known or controlled level.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Corrosion evidenced by holes or loss of base metal.	SF		
***{Severity H}			

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Arrester chipped or cracked.	EA		
***{Severity M}			
b. Arrester broken or missing.	EA		
***{Severity H}			
c. Arrester mounting broken.	EA		
***{Severity H}			
d. Unit not grounded.	EA		
***{Severity H}			

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.04 CIRCUIT BREAKERS (MEDIUM VOLTAGE)

Circuit breakers (medium voltage) are devices used to disconnect loads rated from 601 volts to 35 kV. These type of breakers open and close a circuit when signaled from an outside source. These sources are current and voltage sensing devices such as relays and solid state devices with their associated potential and current transformers or by pushbuttons or selector switches that are manually operated.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Security devices missing or inoperative. ***{Severity H}	EA		
f. Door handle bent or inoperative. ***{Severity H}	EA		
g. Circuit breaker broken or damaged. ***{Severity H}	EA		
h. Pilot light damaged or inoperative. ***{Severity H}	EA		
i. Light monitoring breakers position not lit. ***{Severity H}	EA		

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.04 CIRCUIT BREAKERS (MEDIUM VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Oil Leak:**			
Observation:			
a. Oil on surface of tank (possible oil leak). ***{Severity L}	EA		9
b. Oil puddle under or around base of tank. ***{Severity H}	EA		9

Defect:

	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	11	14
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	11	14

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.05 CIRCUIT BREAKERS (LOW VOLTAGE)

Circuit breakers (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. They contain built-in overcurrent and undervoltage devices to protect down stream conductors and equipment from overcurrent loads. These breakers can be operated automatically by built-in devices or by manually built-in toggle switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered. ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Circuit breaker broken or damaged. ***{Severity H}	EA	4	
g. Security devices missing or inoperative. ***{Severity H}	EA		

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.05 CIRCUIT BREAKERS (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal or breaker body 5° to 24°C above ambient. ***{Severity M}	EA	5	4
b. Terminal or breaker body 25°C or more above ambient. ***{Severity H}	EA	5	4

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.06 DISCONNECT SWITCHES (MEDIUM VOLTAGE)

Fused cut-outs for the purpose of this inspection are considered disconnect switches. Disconnect switches (medium voltage) are devices used to disconnect loads rated from 601 volts to 35 kV from its source.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Unused opening not covered ***{Severity M}	EA		
e. Door handle bent or inoperative. ***{Severity H}	EA		
f. Security devices missing or inoperative. ***{Severity H}	EA		
g. Insulator damage. ***{Severity H}	EA		
h. Carbon tracking due to flashovers. ***{Severity H}	EA		
i. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA		

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ **10.11.06 DISCONNECT SWITCHES (MEDIUM VOLTAGE) (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal or switch body 5° to 24°C above ambient. ***{Severity M}	EA	10	10
b. Terminal or switch body 5° to 24°C above ambient. ***{Severity H}	EA	10	10

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.07 DISCONNECT SWITCHES (LOW VOLTAGE)

Disconnect switches (low voltage) are devices used to disconnect loads rated 600 volts or less from its source. Two types of disconnect switches are fused or non-fused. Disconnect switches are normally manually operated but could be electrically operated.

Disconnect switch with a fuse unit provides both overload and short circuit protection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		

Defect:

*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Door handle bent or inoperative. ***{Severity M}	EA		
e. Unused openings not covered. ***{Severity M}	EA		
f. Security devices missing or inoperative. ***{Severity H}	EA		
g. Carbon tracking due to flashovers. ***{Severity H}	EA	6	
h. Discoloration of blades and contacts due to overheating. ***{Severity H}	EA	6	

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.07 DISCONNECT SWITCHES (LOW VOLTAGE) (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot Spots:**			
Observation:			
a. Terminal, blade end or fuse clip 5° to 24°C above ambient. ***{Severity M}	EA	7	5
b. Terminal, blade end or fuse clip 25°C or more above ambient. ***{Severity H}	EA	7	5

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.08 TRANSFORMERS

Transformers are static electric devices consisting of a single winding or multiple coupled windings with or without a magnetic core. Power is transferred by electromagnetic induction from the input to the output circuit usually with changed values of voltages and currents.

Transformers have six types of functions: power transformers converts one voltage source to another voltage power source, isolation transformers shields the load side winding from the line side winding, reduced voltage starting transformers reduces the motor terminal voltage during the starting cycle, buck/boost transformers either raise or lower output voltage to accommodate the load, current transformers proportions a high current flow to a low current flow for instrumentation and control purpose and potential transformers proportions a high voltage potential to a low voltage potential for instrumentation and control purposes.

Transformers, other than current and potential transformers, smaller than 5 kVA single phase or 15 kVA multi phase, will not be inspected. All current and potential transformers will be inspected.

Surge (lightning) arresters, insulators, foundations, poles and conductors bare will be inspected under separate components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident). ***{Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. ***{Severity M}	SF		11
c. Corrosion evidenced by holes or loss of base metal. ***{Severity H}	SF		11

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Enclosure mounting loose, broken or missing. ***{Severity L}	EA		
b. Panel fastener loose, broken or missing. ***{Severity L}	EA		
c. Enclosure damaged (cannot be sealed). ***{Severity M}	EA		
d. Air intake/exhaust ducts blocked. ***{Severity M}	EA		

10.11 SUBSTATIONS

COMPONENTS (Continued)

◆ 10.11.08 TRANSFORMERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Damage(continued):**			
e. Air filters dirty or missing. ***{Severity M}	EA		
f. Unused opening not covered. ***{Severity M}	EA		
g. Pole mounted transformer leads bare. ***{Severity M}	EA		
h. Cooling fan guard/blade broken or missing. ***{Severity H}	EA		
i. Unit not grounded. ***{Severity H}	EA		
j. Gauge or meter broken or missing. ***{Severity M}	EA		
k. Security lock missing or inoperative. ***{Severity H}	EA		
Defect:			
* **Oil Leak:**			
Observation:			
a. Oil on surface of tank (possible oil leak). ***{Severity L}	EA		12
b. Oil puddle under or around base of tank. ***{Severity H}	EA		12
Defect:			
* **Hot Spots:**			
Observation:			
a. Terminal 5° to 24°C above ambient. ***{Severity M}	EA	8	6
b. Terminal 25°C or more above ambient. ***{Severity H}	EA	8	6
c. Oil cooling fin blocked. ***{Severity H}	EA		13
d. Low oil level (less than 2" above fin). ***{Severity H}	EA		13

10.11 SUBSTATIONS

REFERENCES

1. DOE CAS Manual, Volume 9: 0.09, Electrical

2. National Fire Protection Association (NFPA 70B) *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

3. MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

4. *"Handbook of Building and Plant Maintenance Forms and Checklists"* by Roger W. Liska and Judith Morrison Liska

10.11 SUBSTATIONS

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

1	GS-II 10.11.01-1
2	GS-II 10.11.01-2
3	GS-II 10.11.02-3
4	GS-II 10.11.05-4
5	GS-II 10.11.05-5
6	GS-II 10.11.07-6
7	GS-II 10.11.07-7
8	GS-II 10.11.08-8
9	GS-II 10.11.01-9
10	GS-II 10.11.06-10
11	GS-II 10.11.04-11

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

1	GS-III 10.11.01-1
2	GS-III 10.11.02-2
3	GS-III 10.11.02-3
4	GS-III 10.11.05-4
5	GS-III 10.11.07-5
6	GS-III 10.11-08-6
7*	GS-III 10.11-7*
8	GS-III 10.11.01-8
9	GS-III 10.11.04-9
10	GS-III 10.11.06-10
11	GS-III 10.11.08-11
12	GS-III 10.11.08-12
13	GS-III 10.11.08-13
14	GS-III 10.11.04-14

* Indicates guide sheets which are not directly referenced by a Key. These are "triggered" by information beyond the inspection process such as time, age or repeated service calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.11.01-1

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosure compartments containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure compartment contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.11.01-2

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosure compartments containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure compartment contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-II 10.11.01-2

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: METERING
CONTROL NUMBER: GS-II 10.11.02-3

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosure compartments containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure compartment contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-II 10.11.02-3

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.11.05-4

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.11.05-5

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.
2. Make temperature measurements with an infrared scanner.
3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.
4. Measure the temperature of the device specified.
5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.
6. Record the results.
7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.11.05-5

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 6

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.11.07-6

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection indicates one is required.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.11.07- 7

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.
2. Make temperature measurements with an infrared scanner.
3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.
4. Measure the temperature of the device specified.
5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.
6. Record the results.
7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-II 10.11.07-7

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-II 10.11.08-8

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosure compartments containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure compartment contains circuitry of higher potential, do not use this inspection guide.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully and to the degree required for scanning those devices being tested.

2. Make temperature measurements with an infrared scanner.

3. Measure the ambient temperature by measuring a spot on the inside of the enclosure that is least effected by any internal panel heat source.

4. Measure the temperature of the device specified.

5. Above-ambient temperature is calculated by subtracting the ambient temperature from the device temperature.

6. Record the results.

7. Close panels or doors carefully after the inspection is complete.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 8 (CONTINUED)

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-II 10.11.08-8

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is made.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 9

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.11.01-9

Application

This guide applies to the investigation of voltage unbalances and overcurrent conditions in the inside of an enclosure, containing bare, energized, electrical parts, as applicable to the referenced component.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 600 volts or less above ground. If the enclosure contains circuitry of higher potential, do not use this inspection guide.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the physical inspection.
2. Using the multimeter, take voltage and current flow readings as listed in the standard and tagged for the Level II Key No. as indicated above.
3. A Level II Help Screen Chart will convert readings to percentages by observation.
4. Close panels or doors carefully after the inspection is completed.
5. If readings are out of limits, a Level III analysis is triggered.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

HELP SHEET - KEY NO. 9

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-II 10.11.01-9

ELECTRICAL POWER
CONVERSION TABLE
READINGS PERCENTAGE

Voltage unbalance observations applies to 3 phase loads only. Measure voltage from phase to phase (3 measurements required). Use the difference between the 2 extreme readings.

Nominal Voltage

	208 V	240V	480V
2 to 2.9%	4.2 to 6.1 V	4.8 to 7.1 V	9.6 to 14.3 V
3 to 4.9%	6.2 to 10.3 V	7.2 to 11.9 V	14.4 to 23.9 V
5% or more	10.4 V or more	12.0 V or more	24.0 V or more

Voltage from normal - check 3 phase power only.

Nominal Voltage

	208 V	240 V	480 V
4 to 5.9% (+)	216.3 to 220.4	249.6 to 254.3	499.2 to 508.7
3 to 4.9% (-)	197.7 to 201.8	228.1 to 232.8	456.1 to 465.6
6 to 9.9% (+)	220.5 to 228.7	254.4 to 263.9	508.8 to 527.9
5 to 7.9% (-)	191.5 to 197.6	220.9 to 228.0	441.7 to 456.0
10.0% or more	228.8 or more	264.0 or more	528.0 or more
8.0% or less	191.4 or less	220.8 or less	441.6 or less

Load current - Use nameplate full load current for calculations. When the measured current exceeds the full load current, the % of overload is calculated as follows:

$$\% \text{ Overload} = \frac{(\text{Measured Current - Full Load Current}) \text{ Times } 100}{\text{Full Load Current}}$$

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 10

COMPONENT: DISCONNECT SWITCHES (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-II 10.11.06-10

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 601 volts or more above ground.

2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.

3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.

2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.

3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 11

COMPONENT: CIRCUIT BREAKERS (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-II 10.11.04-11

Application

This guide applies to the investigation of the inside of an enclosure, containing bare, energized, electrical parts.

Special Safety Requirements

The following list of special safety requirements, beyond the requirements listed in the Master Safety Plan and System Safety Section, are to be observed in the performance of this inspection.

1. This inspection guide applies to enclosures containing live electrical parts having a potential of 601 volts or more above ground.
2. Any enclosure that is padlocked for safety reason is not to be opened unless okayed by the person having control of the key.
3. Inspector needs to carefully open, inspect the inside and close the enclosure without shutting down the equipment, and without creating a hazard to himself.

Inspection Actions

1. Open panels or doors carefully as required for doing the visual inspection.
2. Visually inspect for those physical damaged defects that are listed and tagged Level II Key No. as indicated above.
3. Close panels or doors carefully after the inspection is completed.

Recommended Inspection Frequency

Do a Level II inspection each time a Level I inspection is performed on this equipment.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.11.01-1

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ENCLOSURES WITH BUS BARS
CONTROL NUMBER: GS-III 10.11.01-1

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.11.02-2

Application

This guide applies to the investigation of a broken meter that has received physical damage or is not operating.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. For physically damaged units, inspect to verify if the unit is damaged to the point where it is no longer sealed from dust, water or insects entering the housing. If the seal is broken the housing should be replaced and the existing meter should be repaired or discarded.

2. If the meter is not operating, follow the following procedure:

   a. Check all fuses and replace those fuses that are blown.
   b. Check current transformers (CT) for output when power is being used. CT may be burnt out or overloaded. CT secondary circuit must not be opened or overloaded when current flows through the primary. Under the above operating conditions the CT could be destroyed.
   c. Check potential transformers (PT) for output when power is on. PT may not provide the proper voltage output.
   d. Check selector switches for proper operation and low contact resistance. If switch is malfunctioning it should be replaced.
   e. Check circuitry for proper connections. Any improper connection could cause damage to the meter, CT or PT. Damaged devices need to be repaired or replaced.
   f. Check all electrical terminals for loose connections and tighten those required.
   g. Check for broken and insulation-damaged conductors. Replace conductors as required.
   h. After the above items have been checked out, the necessary repairs and replacements have been made and the meter is still malfunctioning, the meter should be replaced and the original meter sent to the shop for repair or scrapping.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.11.02-2

Special Tools and Equipment

The following is a list of special instruments required beyond those listed in the Standard Tool Section.

1. Digital Multimeter, Fluke #1TC67

Recommended Inspection Frequency

Do a Level III inspection only when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.11.02-3

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: METERING
CONTROL NUMBER: GS-III 10.11.02-3

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676 Amp meter, 1% accuracy or better

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.11.05-4

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (CONTINUED)

COMPONENT: CIRCUIT BREAKERS (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.11.05-4

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.11.07-5

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (CONTINUED)

COMPONENT: DISCONNECT SWITCHES (LOW VOLTAGE)
CONTROL NUMBER: GS-III 10.11.07-5

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-III 10.11.08-6

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (CONTINUED)

COMPONENT: TRANSFORMERS
CONTROL NUMBER: GS-III 10.11.08-6

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: SUBSTATIONS
CONTROL NUMBER: GS-III 10.11-7*

Application

This guide applies to the inspection of a substation as a complete subsystem excluding the transformers. The transformers will be inspected under a separate procedure. This inspection, while a part of the Condition Assessment Survey, is triggered by information beyond the inspection process such as time, age, or repeated service calls.

Special Safety Requirements

Inspectors need to have complete control of the substation while performing the inspection. During a portion of the inspection the substation will be taken out of service. Therefore the inspection of the substation will be scheduled accordingly to accommodate the inspection requirements. No other safety requirements are required for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate substation's maintenance log or records and review the following material:
   a. Date of the latest Short Circuit Analysis.
   b. Number of trips per protective device in the last 12 months of operation.
   c. Coordination study of protective device.
   d. Flash over problems.
   e. Scheduled checks for tightness of bus bars and terminal connections.
   f. Adequacy of maintenance logs or records.

2. Specify corrective action for problem areas:
   a. If there has not been a "Short Circuit Analysis" in the last 10 years or since the last incoming power source upgrade, a new study shall be made to determine the availability of short circuit current at various equipment locations.
   b. If a feeder circuit breaker trips or disconnect switch fuse blows more than twice a year, specify an Electrical Energy Analysis be made to verify the size of the existing circuit breakers or disconnect switches and their fuse rating. These units and any associated feeders having incorrect ratings should be changed out.
   c. If a back-up protective device trips or blows consistently before the equipment protective device trips or blows, specify a Protective Device Coordination Study be made for coordinating the characteristics of the protective device.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: SUBSTATIONS
CONTROL NUMBER: GS-III 10.11-7*

Inspection Actions (Continued)

d. If flash overs occur, investigate the problem and indicate the cause.
e. If bus bar connections have not been tightened in the last 5 years, specify these connections be checked for proper tightness per manufacturers recommendation.
f. If some or all of the above information is not available from the maintenance logs or records, request that required records be kept.

3. Provide an inspection of the substation and their components as specified by the equipment manufacturer. If there is no such recommendation, then provide an inspection as outlined in NFPA 70B *"Recommended Practices for Electrical Equipment Maintenance"*, current edition.

The following is a list of special tools and equipment required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek Inc., #PM2EM-L2
2. Torque wrench
3. Refer to manufacturer maintenance guide for additional special tools required

Recommended Inspection Frequency

Follow manufacturers recommendations for frequency of inspection of the substation assembly for the 3 three years. If there is no manufacturer's recommendation than an annual inspection should be performed during this 3 year period. After the first 3 years of service, inspection frequency can be increased or decreased dictated by the past observations or experiences. When the number of service calls since the last inspection equals 4, the up-coming inspection should be performed immediately.

References

1. NFPA 70B, *"Recommended Practice for Electrical Equipment Maintenance"*, 1990 Edition

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: ENCLOSURE WITH BUS BARS
CONTROL NUMBER: GS-III 10.11.01-8

Application

This guide applies to the investigation of enclosure with bus bars that are overloaded.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning power input to the enclosure with bus bars.

2. Check for voltage unbalance by isolation to determine the source of unbalance. First check out the power source with the rest of the system disconnected. Second check out the unit with the input connected and the load or loads disconnected. Third check out the loads by adding one load at a time.

3. Check for over/under voltage problems by checking at different points up-stream of the unit to determine if the conductors are to small, equipment overloaded or transformer taps not properly set.

4. Check for over current by adding up the nameplates loads of the devices being fed that are on lines. If this calculated load is less than the measured load then check each individual load to determine which device is being overloaded.

5. After the appropriate data is collected determine what correction action has to be taken.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Voltmeter

2. Ampmeter

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: CIRCUIT BREAKER (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-III 10.11.04-9

Application

This guide applies to the investigation of oil leaks in the circuit breaker tank that has signs of oil on surface of the tank or an oil puddle under or around base of tank.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by finding the source of the oil. If the oil is coming from an external source no further inspection of the breaker is required. The external source should be identified and recommendations made to eliminate the contamination of the breaker.

2. If the oil source is coming from within the breaker, a determination should be made as how the oil is escaping.

3. If breaker repairs are made, oil analysis should be made after the repairs to determine if the oil is contaminated.

4. All contaminated oil should be removed and replaced with new oil.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Brush

2. Non-flammable cleaning fluid

3. Wiping material

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: DISCONNECT SWITCHES (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-III 10.11.06-10

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10 (Continued)

COMPONENT: DISCONNECT SWITCHES (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-III 10.11.06-10

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2
2. Torque wrench
3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*
2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.11.08-11

Application

This guide applies to the investigation of 112.5 kVA transformers or larger that contain liquids used as electrical insulation and coolant.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning the corrosive condition of the tank containing the coolant and insulation liquid.

2. If the tank has corroded to the point where contaminated air could possibly pass through the tank wall an oil analysis should be performed.

3. If the liquid is contaminated, provide test to determine how the tank leaks.

4. Analyze the test results to determine whether the transformer can be repaired or must be replaced.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Wire brush

2. Wrenches

3. Pressure gauge

4. Inert gas supply

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.11.08-12

Application

This guide applies to the investigation of oil leaks in the transformer tank that has signs of oil on surface of the tank or an oil puddle under or around base of tank.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection by finding the source of the oil. If the oil is coming from an external source no further inspection of the transformer is required. The external source should be identified and recommendations made to eliminate the contamination of the breaker.
2. If the oil source is coming from within the transformer, a determination should be made as how the oil is escaping.
3. If transformer repairs are made, oil analysis should be made after the repairs to determine if the oil is contaminated.
4. All contaminated oil should be removed and replaced with new oil.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Brush
2. Non-flammable cleaning fluid
3. Wiping material

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13

COMPONENT: TRANSFORMER
CONTROL NUMBER: GS-III 10.11.08-13

Application

This guide applies to the investigation of 112.5 kVA transformers or larger that contain liquids used as electrical insulation and coolant.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level I inspection concerning cooling fin blockage or low liquid level.
2. Do a liquid analysis test.
3. If liquid analysis test results are okay, add liquid to proper level requirements.
4. If fin blockage remains, have liquid removed and clear the fin blockage.
5. If liquid analysis test results show contaminates, have the liquid removed, the contaminates flushed out and new liquid added.

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared scanner
2. Tools and sampling containers for taking liquid samples and transferring these samples to the lab.
3. Tools and liquid supplies for adding the appropriate liquid to the transformer tank.

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level I inspection.

References

1. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14

COMPONENT: CIRCUIT BREAKERS (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-III 10.11.04-14

Application

This guide applies to the investigation of a hot terminal or device that is overheating from the flow of current through that terminal or device.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Verify the findings of Level II inspection by using the Infrared Scanner and measuring the temperatures of the device and terminals. If the device or terminals are not hot as indicated by the findings of Level II inspection, check the current flow through the device or terminals. Heat generated is proportionate to the square of the current. If there is little or no current flow through the device or terminal at the time of measurement, there will be no significant amount of heat generated.

2. For terminal connections, verify the type of conductor being terminated. If the conductor is an aluminum conductor, look for evidence of cold flow or melt down of conductor.

3. If there is evidence of cold flow or melt down of the aluminum conductor, the conductor should either be replaced or shortened and reconnected. When making new aluminum conductor terminations a joint compound should be used.

4. If the terminal is loose it should be tightened. De-energize prior to attempting tightening of terminal connections.

5. If none of the above is the problem than there is an internal problem and an on-site analysis must be made to determine if additional inspections are to be made or the unit is to be replaced.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14 (Continued)

COMPONENT: CIRCUIT BREAKERS (MEDIUM VOLTAGE)
CONTROL NUMBER: GS-III 10.11.04-14

Special Tools and Equipment

The following is a list of special tools required beyond those listed in the Standard Tool Section.

1. Infrared Scanner, Raytek, Inc., #PM2EM-L2

2. Torque wrench

3. Digital Multimeter, Fluke #1TC676

Recommended Inspection Frequency

Do a Level III inspection when triggered by a Level II inspection.

References

1. Maintenance Technology/September 1993; Write-up Title: *"Infrared Keeps All Systems Go"*

2. Raining - Agema Infrared Systems; *"Measurement of Excess Temperatures with Infrared Scanners"*

APPENDIX A

ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADF	Asset Determinant Factor
A/E	Architect/Engineer
AFM	U.S. Air Force Manual
AGC	Associated General Contractors
ALUM	Aluminum
Amp	Ampere
ANSI	American National Standards Institute
ARTBA	American Road and Transportation Builders Association
AVG	Average
AWG	American Wire Gauge
B	Bus
BRKR	Breaker
BLDG	Building
BOCA	Building Official Code Association
°C	Degrees Centigrade (Celsius)
CAIS	Condition Assessment Inspection Survey
CAS	Condition Assessment Survey
CHRGR	Charger
CIRC	Circuit
COE	U.S. Army Corps of Engineers
COMBIN	Combination
COR	Contracting Officer Representative
CSI	Construction Specification Institute
CT	Current Transformer

APPENDIX A

CTR	Center
CTRLS	Controls
DBL	Double
DC	Direct Current
DCD	Data Collection Device
DIA	Diameter
DIST	Distribution
DM	NAVFAC Design Manual
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DR	Door
DS&IM	Deficiency Standard and Inspection Method
EA	Each
EM	U.S. Army Engineering Manual
EMS	Energy Management System
ENCL	Enclosure
EPA	U.S. Environmental Protection Agency
Est	Estimated
EXPLOSION PRF	Explosion Proof
EXTER	Exterior
F	Fahrenheit
FLR	Floor
Ft	Foot, feet
FVNR	Full Voltage, Non-Reversing
FVR	Full Voltage, Reversing
Galv	Galvanized

APPENDIX A

GS	Guide Sheet
HID	High Intensity Discharge
HOA	Hand-Off-Automatic
HP	Horsepower
HR	Hour
HVAC	Heating, Ventilating, and Air-Conditioning
Hz	Hertz, frequency
IC	Integrated Circuit
IEEE	Institute of Electrical and Electronic Engineers
IES	Illumination Engineering Society
IR	Infrared
ITIM	Intrusive Test and Inspection Method
IU	Inspection Unit
JAWSKT	Jaw Socket
JWSKTS	Jaw Sockets
KA	Kiloampere
KV	Kilovolt
kVA	kiloVolt Ampere
kVAR	Kilovar
kW	kiloWatt
kWh	kiloWatt hour
LF	Linear Feet
LGHT	Light
MC	Major Command/Major Claimant
MCC	Motor Control Center
MCP	Motor Control Panel

APPENDIX A

Mfg	Manufacturing
Mfr	Manufacturer
Mhz	Megahertz
MN	Main
MSDS	Material Safety Data Sheet
MTD	Mounted
MVA	Million-Volt-Amps
MYMARP	Multi-Year Maintenance and Repair Plan
NAVFAC	Naval Facilities Engineering command
NDT	Non-Destructive Testing
NEHB	Type of Panel Bolt On
NEHP	Type of Panel Plug In
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSTIM	Non-Standard Testing and Inspection Method
OD	Outside Dimension
OSHA	Occupational Safety and Health Administration
P	Phase
PANELBD	Panelboard
PB	Pushbutton
PCB	Polychlorinated biphenyls
PL	Pilotlight
PT	Potential Transformer
PVC	Polyvinyl Chloride
QA	Quality Assurance
REG	Regulator

APPENDIX A

Reqd	Required
RMS	Root Mean Square
RPI	Real Property Inventory
RPFM	Real Property and Facilities Management (U.S. DOE)
RPIL	Real Property Inventory List
RPIS	Real Property Inventory System (U.S. DOE)
RV	Reduced Voltage
RVA	Reduced Voltage Autotransformer
RVRes	Reduced Voltage Reactor
SCR	Silicon-Controlled Rectifier
SERV	Service
SF	Square feet
SGL	Single
SIM	Standard Inspection Method
SQ	Square
SS	Stainless Steel
STRTR	Starter
SW	Switch
SWITCHBD	Switchboard
SZ	Size
TM	U.S. Army technical manual
TR	DOD technical report
UL	Underwriters Laboratory
UOM	Unit of Measure
UPS	Uninterruptible Power Supply
USCE	U.S. Army Corps of Engineers

APPENDIX A

V	Volt
VAC	Voltage, Alternating Current
VAR	Variable
VDC	Voltage, Direct Current
W	Watt
W/	With
WATERPRF	Waterproof
WBS	Work Breakdown Structure
XFR	Transformer
Yrs	Years
2S1W	Two Speed, single winding
2S2W	Two Speed, two winding
2MC	Two Magnetic Contractors
°F	Degrees Fahrenheit
°C	Degrees Centigrade (Celcius)
<	Less Than
>	Greater Than
%	Percent
/	and
+	Plus
'	Foot or Feet
"	Inch or Inches

APPENDIX B

GLOSSARY

Accessible	Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building (as applied to wiring methods).
Ancillary Equipment	Selected equipment such as but not limited to meters, instrument transformers and surge arrestors. Specifically, items of equipment installed or in place only as augmentation to another device.
Bonding	The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.
Branch Circuit	The circuit conductors between the final overcurrent device and the outlet(s).
Buildings	A structure which stands alone or which is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors.
Circuit Breakers	A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.
Device	A unit of an electrical system which is intended to carry but not utilize electric energy.
Enclosure	The case of housing of apparatus, or the fence, or walls which will prevent persons from accidentally contacting energized parts.
Equipment	A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with, an electrical installation.
Feeder	All circuit conductors between the service equipment of the source of a separately derived system and the final branch circuit overcurrent device.
Fitting	An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function
Instrumentation Device	Devices that are utilized to test, observe, measure, monitor, alter, generate, record, calibrate, manage, or control physical properties, movements or other characteristics.

APPENDIX B

Insulator	(1) Power Switchgear A device intended to give flexible or rigid support to electrical conductors or equipment and to insulate these conductors or equipment from ground or from other conductors or equipment. An insulator comprises one or more insulating parts to which connecting devices (metal fittings) are often permanently attached. (2) Transmission and Distribution Insulating material in a form designed to support a conductor physically and electrically separate it from another conductor or object.
Outlet	A point on the wiring system at which current is taken to supply utilization equipment.
Overcurrent	Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.
Overload	Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity which, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault is not an overload.
Panelboard	A single panel or group of panel units designed for assembly in the form of a single panel; including bases, automatic overcurrent devices, and with or without switched for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall of partition and accessible only from the front.
Raceway	An enclosed channel designed expressly for holding wires, cable, or busbars, with additional functions as permitted. Raceways may be of metal or insulating material, and the term includes rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquid tight flexible conduit, flexible metallic conduit, electrical nonmetallic conduit, electrical metallic conduit, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busyways.
Service Drop	The overhead conductors that extend from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.

APPENDIX B

Service Entrance Conductors	The service conductors between the terminals of the service equipment and point usually outside the building, clear of building walls, where joined by tap or splice to the service drop or the service conductors between the terminals of the service equipment and the point of connection to the service lateral. The service conductors may be individual insulated conductors or in the form of a cable. The insulation will be appropriate to the environmental application.
Service Entrance Equipment	The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.
Service Lateral	The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service entrance conductors in a terminal box or meter or the enclosure with adequate space, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure with adequate space, the point of connection will be considered to be the point of entrance of the service conductors into the building.
Switchboard	A large single panel, frame, or assembly of panels on which are mounted, on the face or back or both, switches, overcurrent and other protective devices, buses, and usually instruments. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.
Utilization Equipment	Equipment which utilizes electric energy for mechanical, chemical, heating, lighting, or similar purposes.

APPENDIX C

LIFE CYCLES

10 BUILDING ELECTRICAL

10.01 SERVICE ENTRANCE, 600v OR LESS

Meters	20 YRS
Circuit Breakers	50 YRS
Disconnect Switches	25 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.02 LOW VOLTAGE DISTRIBUTION SYSTEM, 600v OR LESS

Circuit Breakers	50 YRS
Disconnect Switches	25 YRS
Transfer Switches	18 YRS
Motor Starters/Contactors	18 YRS
Power Regulators	18 YRS
Transformers	30 YRS
Variable Frequency Drives	20 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.03 LIGHTING

Lighting Fixtures	20 YRS
Luminous Ceiling	20 YRS*
Lighting Controllers	15 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

* Assumed life cycle same as Lighting Fixtures

10.04 POWER CONTROL

Control Panels	15 YRS
Control Stations	15 YRS

Source:
MEANS *"Facilities Maintenance & Repair Cost Data"*, 1994

APPENDIX C

10.05 GROUNDING SYSTEM

Bonding	50 YRS
Grounding System	50 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.06 RACEWAYS

Busways/Busducts	20 YRS
Cable Trays	20 YRS
Conduit Systems	50 YRS
Wireways	20 YRS
Underfloor/Infloor Duct System	50 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.07 POWER SOURCES

Battery Racks	50 YRS*
Battery Chargers	20 YRS
Battery, Storage (Lead Acid)	10 YRS
Battery, Storage (Nickel Cadmium)	20 YRS
Motor-Generator Sets	15 YRS
Solid State Frequency Converters	15 YRS
Solid State Uninterruptible Power Supply	15 YRS
Solid State Power Conditioners	15 YRS
Engine-Generators	25 YRS

Source:
DOE CAS Manual, Volume 9:0.09 Electrical, Section 1, Standard System Design Life Tables
Unitron Incorporated
MEANS Facilities Maintenance & Repair Cost Data, 1994

* Assumed life cycle

APPENDIX C

10.08 MOTOR CONTROL CENTERS (MCC)

Enclosure with Bus Bars	20 YRS
Circuit Breakers	50 YRS
Disconnect Switches	25 YRS
Motor Starters/Contactors	18 YRS
Transformers	30 YRS
Transfer Switches	18 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.09 SWITCHBOARDS

Enclosures with Bus Bars	20 YRS
Meters	20 YRS
Transfer Switches	18 YRS
Circuit Breakers	50 YRS
Disconnect Switches	25 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.10 PANELBOARDS

Enclosures with Bus Bars	20 YRS
Circuit Breakers	50 YRS
Disconnect Switches	18 YRS
Motor Starters/Contactors	18 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data, 1994

10.11 SUBSTATIONS

Enclosures with Bus Bars	20 YRS
Meters	20 YRS
Surge (Lightning) Arresters	60 YRS
Circuit Breakers	50 YRS
Disconnect Switches	25 YRS
Transformers	30 YRS

Source:
Means Facilities Maintenance & Repair Cost Data, 1994
Joslyn Manufacturer